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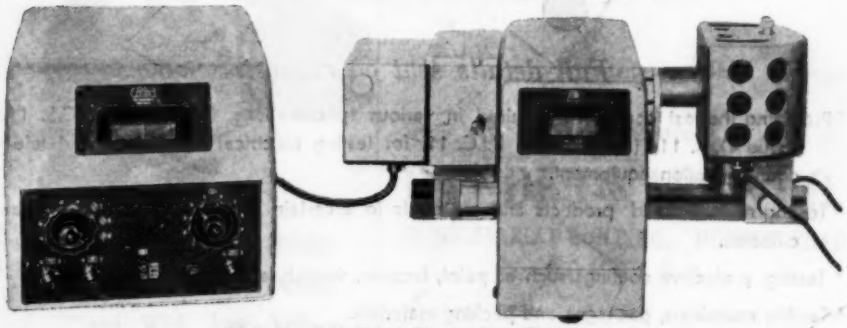

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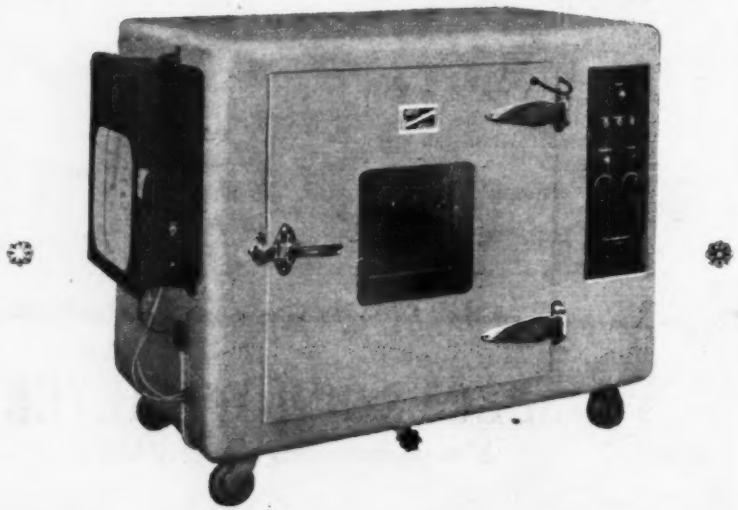

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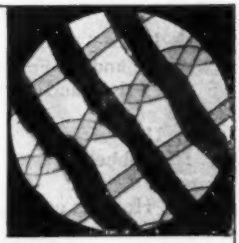

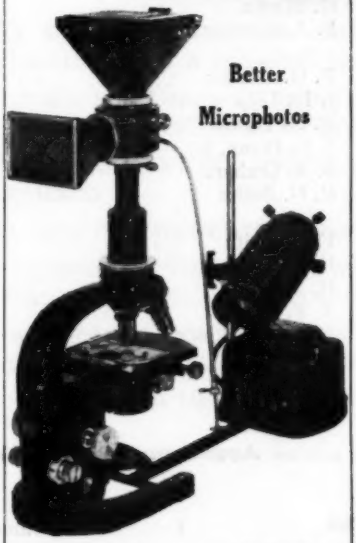

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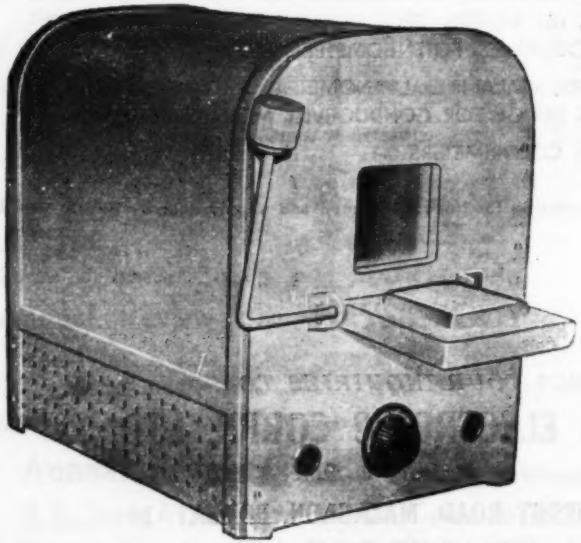

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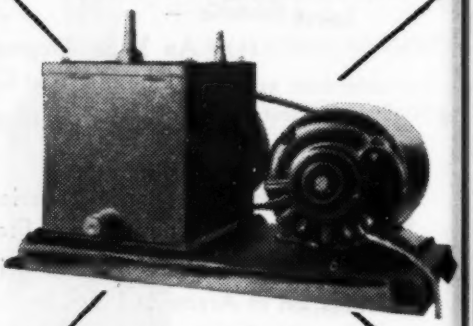

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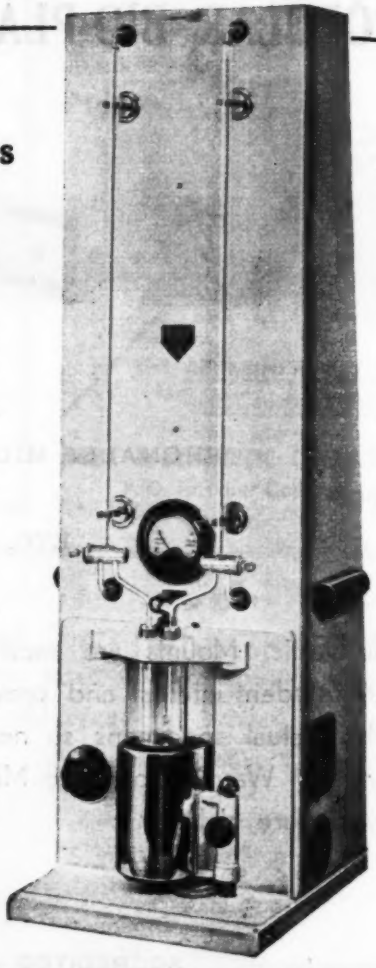

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THE PROBLEM OF DOMESTIC FUEL*

IN India at present, about 80 million tons of cowdung cake, equivalent to about 40 million tons of coal and about 35 million tons of fuel-wood, equivalent to about 19 million tons of coal, are being used as domestic fuel. All the fuel wood and charcoal is derived by cutting down trees in forests, wastelands and private gardens. Forest statistics indicate that afforestation is lagging far behind deforestation. The devastating results of deforestation and insufficient afforestation as well as of burning farm waste, such as severe soil erosion, extensive floods, irregular weather conditions and growth of waste lands are now well known. It is therefore imperative that in order to improve the fertility of the Indian soil and to develop the country's agricultural resources and production, the consumption of fuel wood, charcoal and farm waste must be cut down drastically, and the fuel habits of the public should be changed so as to replace the present fuels with coal and coal products.

If India is to have a rational fuel policy for the future, it is necessary to consider the present and the likely future patterns of energy utilisation in the country. Approximate estimates indicate that the annual total energy required by about 1970-75 would be about $5{,}000 \times 10^{12}$ B.T.U. as against about $3{,}600 \times 10^{12}$ B.T.U. at present. It is further estimated that the future energy pattern would include about 60% from coal, about 30% from wood and farm waste, and the rest from oil and hydropower. The present level of wood and farm waste consumption for fuel is therefore expected to be reduced by more than 50% and coal and oil energy correspondingly increased. Approximate calculations made on this basis show that about 20 million annual tons of semi-coke would be needed as domestic fuel, assuming that no increase would take place in future in the quantum of energy derived from wood and farm waste. Likewise, the railways are also expected to expand in future in the direction of diesel and electric locomotion, reducing the present wasteful method of steam locomotion based on raw coal. It is thus

* Abstract of the Presidential Address by Dr. S. Husain Zaheer to the Chemistry Section, 43rd Indian Science Congress, Agra, 1956.

clear that a rationalisation is absolutely essential in the development and utilisation of the fuel resources of the country if the fuel habits of the public are to progress from the 'cowdung age' to the 'coal age'.

It is not merely essential to bring about an overall rationalisation in energy utilisation in the country, but also in each sphere it is necessary to tap the right source for any desired purpose. In order to produce semi-coke by low temperature carbonisation, it is necessary from the view-point of conservation of high grade Indian coals, to depend mainly on non-caking coals, high-ash caking slacks and lignites which are unsuitable for use in blast furnaces. The reserves of non-caking coals up to 16% ash and lignites are estimated at about 8,000 million tons distributed all over India. The present demand for semi-coke in important cities and townships in the country is estimated to be more than 5 million annual tons. It is thus entirely feasible to establish a series of low temperature carbonisation plants in the important coal- and lignite-bearing areas of the country so as to regionalise production and facilitate distribution.

Enormous possibilities exist in this country for the development of low temperature carbonisation industry. On the basis of the types of coals available in our country, it would be desirable to establish plants in four major regions from the points of view of availability of raw materials and necessity for convenient distribution of smokeless domestic fuels. These regions are: Neyveli in Madras State, Kothagudium in Hyderabad State, Madhya Pradesh and Bengal-Bihar coalfields. It would be further necessary to instal suitable size tar distillation and processing and tar acid recovery plants to produce tar crudes or finer chemicals or other products as desired.

Dr. H. K. Sen was the first to draw the attention of Indian scientists in 1940 to the possibilities of low temperature carbonisation of coal, and a plant designed by him is in operation at the Lac Research Institute, Ranchi. About five years ago, the Central Laboratories for Scientific and Industrial Research, Hyderabad, studied the low temperature carbonisation of non-caking coals available in large quantities in the State and decided to instal a 25 tons/day plant of Lurgi-Spuelgas type. The plant has been in intermittent operation since January 1954 and so far about 4,000 tons of coal have been processed. About 2,200 tons of semi-coke, 'coalsite' as it has been commercially termed, have been sold in the two cities of Secunderabad and Hyderabad as domestic fuel. The semi-coke is sufficiently hard to withstand all stages of handling and has proved a good domestic fuel. Two types of coal from Hyderabad coalfields were tested in this plant and further tests on the influence of temperature and time of carbonisation are in progress. A 3 tons/day tar distillation plant will be installed shortly to produce commercial products for direct sale and for recovery of tar acids and diesel oil. Laboratory investigations to increase the yield of pitch for road tar preparation by air-blowing are in progress. Work has also been taken up on extraction of pure tar acids from tar oils and liquors and the identification of tar acids by chromatography. Based on these tests, the Government of Hyderabad has submitted proposals for a 800 tons/day L.T.C. plant for inclusion in the Second Five-Year Plan of the State.

It is understood that proposals for such plants have also been submitted by various State Governments for inclusion in the Second Five-Year Plan. The total semi-coke production from all these proposals is expected to be about 2·9 million annual tons with about 360,000 tons of low temperature tar as by-products.

BENJAMIN FRANKLIN

IN connection with the 250th Anniversary of Benjamin Franklin which is being celebrated in 1956 the world over, the following extract from a letter addressed by him to Joseph Priestley, dated February 8, 1780, will be read with great interest:

> "The rapid Progress *true* Science now makes, occasions my regretting sometimes that I was born so soon. It is impossible to imagine the Height to which may be carried, in a thousand years, the Power of Man over Matter. We may perhaps learn to deprive large Masses of their Gravity, and give them absolute Levity, for the sake of easy Transport. Agriculture may diminish its Labour and double its Produce; all Diseases may by sure means be prevented or cured, not excepting even that of Old Age, and our Lives lengthened at pleasure even beyond the antediluvian Standard. O that moral Science were in a fair way of Improvement, that Men would cease to be Wolves to one another, and that human Beings would at length learn what they now improperly call Humanity."

THE ESTIMATION OF MUTATION RATES PRODUCED BY HIGH ENERGY EVENTS IN MAMMALS

J. B. S. HALDANE

University College, London

IT is feared that the dissemination of radioactive elements from thermonuclear explosions may cause numerous mutations in man. It is also important to know what risks to future generations are run in the industrial use of atomic fission, and in the mining of uranium and thorium. The problem cannot be studied experimentally in men; it can be studied in mice.

Most mutations detectable in Drosophila are recessive lethals. The same is probably true in mice. How shall we find out how many are produced by a given dose? If a male mouse receives a large dose, say 400 roentgens, it is at first sterilized, but on recovery it produces mutated gametes. Russell[1] irradiated males homozygous for 7 dominant genes, and mated them to recessives. He found 54 mutations of these 6 genes in 48,007 mice, as compared with 2 in an almost equal number of controls. But though about half of these were lethal when homozygous, we do not know what happened at the many thousands of other loci in their chromosomes.

Suppose we make up two stocks of mice, one homozygous for about 8 dominant genes AA BB CC..., the other for their corresponding recessives *aa bb cc*.... The genes can be for colour (for example recessive black) and structure (for example recessive wavy hair). Members of the recessive stock are irradiated during one or more generations, and a recessive mouse with irradiated ancestors is mated with a multiple dominant. A pair of their progeny is bred together, and a large F_2 generation is raised. Now suppose that, as the result of irradiation, the recessive grandparent is *aL/al*, where L is a normal gene and *l* a lethal on the same chromosome as the recessive gene *a*. Then in the absence of a lethal, we expect $\frac{1}{4}n$ *aa* (recessive) mice in an F_2 of n members. In presence of a lethal we expect xn, where $x = 1/3(c + c' - cc')$, c and c' being the frequencies of recombination between *a* and *l* in the two sexes.

We shall suspect a lethal if our F_2 of n contains r or fewer recessives, where r is a function of n to be fixed in advance. The probability of suspecting a lethal which is not in fact present is $3^{n-r}\,4^{-n}\sum_{i=0}^{r} 3^{r-i}\binom{n}{i}$. We can therefore choose r for each value of n so that this probability does not exceed some small quantity, say 1/300. In this case, for example $r = 0$ when n has any value from 20 to 27, and $r = 1$ when n has any value from 28 to 34.

Given our table of r as a function of n we ask what is the probability of detecting a lethal with given values of c and c'. This probability is $P(n, r, x) = \sum_{i=0}^{r}\binom{n}{i}x^i(1-x)^{n-i}$. This is unity when $x = 0$, but for values of n of the order of 40 it falls to ½ when x is about ·06, or c and c' about ·09. We then ask, assuming $c = c'$, what is the mean length of "linkage map" of the chromosome searched. It is

$$s = \int_0^{\frac{1}{2}} P\ (n, r, x)\ dc$$

The chromosome is searched on both sides of the locus of *a*, but it is only searched in one half of the F_2 families examined.

Now

$$\frac{dc}{dx} = \frac{3}{2}(1-3x)^{-\frac{1}{2}},$$

so

$$s = \frac{3}{2}\int_0^{\frac{1}{2}} P\ (n, r, x)\ (1-3x)^{-\frac{1}{2}}\,dx.$$

But we have chosen r so that $P(n, r, \frac{1}{4})$ is negligible, while $P(n, r, 0) = 1$. So we can put, with a small error

$$s = \frac{3}{2}\int_0^1 P\ (n, r, x)\ (1-3x)^{-\frac{1}{2}}\,dx$$

$$= \frac{3}{2}\int_0^1 P\ (n, r, x)\left(1 + \frac{3}{2}x + \frac{27}{8}x^2 + \ldots.\right)dx$$

Now

$$\int_0^1 x^k P(n, r, x)\,dx = \sum_{i=0}^{r}\binom{n}{i}\int_0^1 x^{i+k}(1-x)^{n-i}\,dx$$

$$= \sum_{i=0}^{r}\frac{(i+1)\ (i+2)\ldots.(i+k)}{(n+1)(n+2)\ldots.(n+k+1)}$$

$$= \frac{(r+1)(r+2)(r+3)\ldots(r+k+1)}{(k+1)(n+1)(n+2)\ldots(n+k+1)}$$

Hence we find

$$s=6(r+1)\ [4n-3r-2+O\ (n^{-1})]^{-1}.$$

It is usual to measure map distances on the chromosomes in units corresponding to 1 per cent. recombination. So, for example, the examination of an F_2 of 30 mice, a lethal gene being suspected if $r=1$, that is to say if one or no recessives are present, will, on an average, search 10·4 such units (centimorgans). The details of mouse genetics enable a somewhat greater length to be searched in some cases. As the total map length of the autosomes is about 1,700 centimorgans it should be possible to search about 5 per cent. of it if the average number in an F_2 examined is about 30.

However, owing to the concentration of genes in certain parts of the linkage map, it is likely that the fraction detected will somewhat exceed 5 per cent.

We have no clear idea of how many lethals to expect. We might for example search chromosomes which, in several irradiated generations, have received a total dose of 1,200 roentgens. The production of lethals in Drosophila spermatozoa is about 1 per 10,000 roentgens, and perhaps 1 per 40,000 if the animals are steadily irradiated through their life-cycle. But a mouse has 30 times as much desoxyribonucleic acid per nucleus as a Drosophila. If this is equally radiosensitive (which is a mere guess) we should expect about one lethal in a mouse whose chromosomes (or rather their ancestors) have received 1,200 r. We should detect this, on an average, once in 20 F_2's examined. This would involve the examination of about 600 mice, and the breeding of about 800. The proof that a lethal was present might entail the examination of another hundred or so. Thus the breeding of 10,000 mice would either give an estimate of the frequency with which lethal genes are produced, or show that it is much less frequent than the above guess (which is rather below the frequency deduced from an extrapolation from Russell's data) suggests.

If the frequency is anywhere near the order suggested, it would be quite practicable to repeat the experiment on mice whose ancestors, for many generations, have received a dose throughout life of less than one roentgen per day. In such circumstances one would expect to find very few lethals due to the recombination, in abnormal patterns, of chromosomes in which two simultaneous breaks have occurred. These are probably common where massive doses are given in a short time.

It is further desirable that a rough comparison of the frequencies of mutation of human genes and mouse genes should be carried out. This could probably be done by irradiating tissue cultures in which the cells carry a genetically determined antigen such as B. Cells lacking it would not be killed by a powerful anti-B serum. Care would have to be taken to distinguish between the effects of mutation and somatic crossing over in removing the gene producing the B antigen.

My reason for publishing in India this very condensed summary of a paper which, I hope, will appear elsewhere in full, is as follows. The method described may well be used in one of the States which are making atomic bombs or is allied with such a State. In such a State there will inevitably be a tendency, if not to suppress results which might suggest that these bombs were dangerous to the whole world population, at least to minimize their importance. In India or Japan there will be an equal tendency to exaggerate them. If the results obtained in countries of both types are in substantial agreement, truth will probably have been achieved.

It can be argued that the suggested experiment is cruel to the mice concerned. However, irradiation is painless, and most of the lethal genes will probably act before birth or immediately afterwards. It is certainly less cruel than the destruction of mice by many of the types of poison and trap which are in common use, or even by cats, which seldom kill mice quickly. Nevertheless I must admit that some mice will be born with potentially painful diseases. I can only say that, perhaps wrongly, I prefer to contemplate such conditions in mice rather than men.

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1. Russell, W. L., *Radiation Biology*, 1954, **1**, 125.

SAND SORTING ON THE EAST COAST BEACHES

C. BORRESWARA RAO AND E. C. LA FOND

Andhra University, Waltair

THE beach is a zone of interaction between sea, land and atmosphere. By virtue of the properties of, and the forces in, these three media, the beach becomes a continuous sorting ground for the sediments deposited there by rivers, by coastal erosion, and by other means. The material is sorted according to size, the coarse sand remaining on the beach, thereby the finer sediments being carried progressively further out to sea. The sand is also sorted according to density, that is, the lighter mineral sand grains are separated from the heavier mineral concentrates. Because of its scientific and economic importance considerable study has been devoted to this sorting feature.

Under the Andhra University's Oceanographic Programme and the Scheme sponsored by the Department of Atomic Energy, the nature, origin, and distribution of heavy mineral sands occurring along the east coast off Visakhapatnam have been studied and reported.[1–6] This present study deals with a new aspect, namely, the deposition and sorting of heavy mineral sands on the beach at the confluence of rivers. To achieve this, repeated surveys have been carried out along the coastal strips and river banks near the confluences of the Vamsadhara, Nagavali, Vainateyam and Vasishta Godavari rivers.

On each survey the distribution of heavy mineral concentrates, both laterally and with depths down to the level of the water table, was recorded. Additional information was also obtained on sand levels, tide heights, wind, waves, current, river run-off and related factors which control deposition and sorting. In order to provide a seasonal trend in sand conditions at these confluences, the surveys covered the periods of February-March, August-September, and November-December.

With the exception of the Vainateyam river, the distribution of sorted sand was found to be similar. The northern coastal strips near the confluences of Vamsadhara and Nagavali rivers consisted of well-sorted concentrates of heavy minerals, with decreasing richness northwards. In contrast, the southern coastal areas were composed of ill-sorted mixed sands. Likewise, the beach strip east of the Vasishta Godavari confluence and the eastern bank of the river contained well-sorted heavy mineral patches, decreasing eastwards. Here, too, the western bank contained mixed sand, except for a few minor patches of heavy black sands. This unilateral distribution and relative richness of heavy mineral concentrates typical of each of the above three rivers, is graphically represented in Fig. 1.

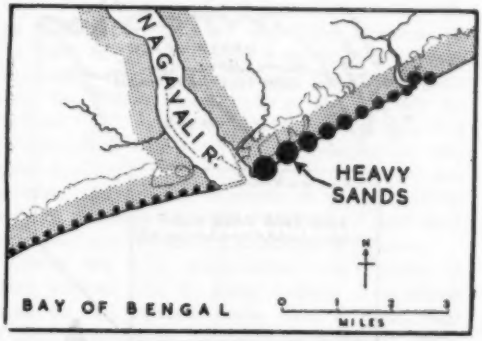

FIG. 1. Location and comparative abundance of heavy mineral sands at river confluences.

The materials from which both the light and heavy mineral sands derive have been transported to the coast by the major and minor drainage systems of the area, with a small amount from erosion of the coast itself and from offshore deposits. At the confluences this mixture is subjected to the processes of deposition and sorting.

The period of maximum river flow and sand deposition occurs in August-September. Under such turbulent conditions the eroded sediments are carried in suspension or flow along the river bottom. As the river approaches the confluence a shoal bar of sand extending from the south or west bank changes its direction and reduces its speed of flow. This deflection of direction is augmented by the drift of the slow northerly current along the beach, and by the predominate swell and waves from the south.

The deposition of material is brought about mainly by the reduced speed and turbulence in the river as it reaches the confluence. This slackening in speed is further affected by the spreading out of the river over its delta and by the deepening of the water in the Bay beyond the sand bank. The higher sea-level, lower sand-level, and larger waves at this time of the year facilitate deposition over a large

area. The waves striking the beach from a southerly angle tend to deposit the sand mixture on the left-hand side of the confluence. The predominant northerly flow of sand along the beach allows little of the river deposited material to accumulate to the south or west of the confluence. These, then, are the factors instrumental in producing a deposit of ill-sorted sand, especially off the north and east side of the river mouth. See Fig. 2 A.

the sea. The wind also acts as a sand sorter by blowing away the light dry sands, sometimes to form sand dunes, and leaving a thin dark heavy mineral layer on the surface of the upper beach. Therefore, the sorting results in layers and patches of heavy minerals interspersed with lighter sands. Heavy minerals concentrate, particularly at the high tide level.

Sorting is a continual process, though its effect reaches a maximum in the February-

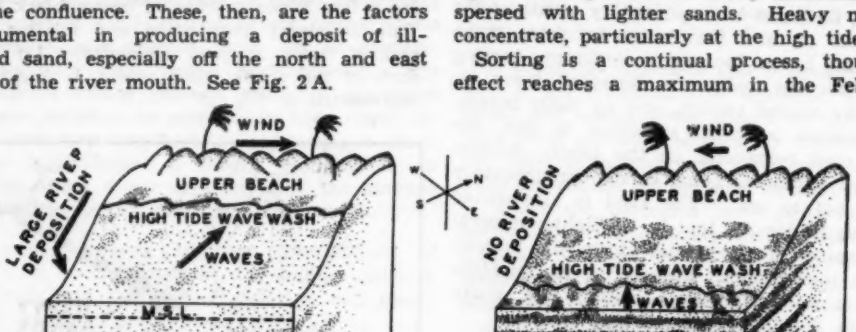

FIG. 2. Environmental conditions on the beach when sand is (A) deposited in August and (B) sorted in February.

The newly deposited sand is loosely packed and is easily subjected to the sorting action of the waves, tides, currents and wind. The waves break at different levels on the beach depending upon their size, and upon the relative levels of the sea, tide and sand. As the waves break, they churn sand into suspension from which it is easily moved along the beach by the near-shore current. However, the lighter sands remain in suspension longer and are transported faster and farther, leaving behind the denser heavy mineral sands. Also, the long sweep of the swash and backwash of the larger waves develops a panning action, bringing the lighter sands to the surface and thus making them more available for transport up the coast. Though some heavy materials may be transported short distances, the heavy fractions tend to accumulate at the confluences, especially on the north side where most of the river sediments are deposited.

The beach sands are not sorted uniformly because the waves, tides, currents, etc., are not constant. Under quiet conditions, there exists a shoreward "creep" of off-shore sediments, and during storms the movement is towards

March period. At this time, the sea-level is at a minimum, the waves are lowest, and the deposition of mixed material by the rivers is relatively small or virtually nil. See Fig. 2 B.

In summary, the river sediments are deposited largely on the north and east side of the confluence. Here sorting takes place through the combined action of waves, currents, tides, sea-level, and wind. The lighter component is carried away leaving layers and patches of heavy mineral concentrates, which decrease in richness to the north and east of the confluences. Thus can be explained the unilateral distribution of these heavy mineral sands along the east coast beaches.

1. Mahadevan, C. and Sriramadas, A., *Proc. Indian Acad. Sci.*, 1948, **27A**, No. (4), 275-78.
2. —, and Sathapathi, N., *Curr. Sci.*, 1948, **17**, 297.
3. —, and Nateswara Rao, B., *Ibid.*, 1950, **19**, 48-49.
4. Sriramadas, A., *Quart. J. Geo. Min. Met. Assoc. India*, 1951, **23** (4), 169-180.
5. La Fond, E. C. and Prasada Rao, R., *Andhra University Memoirs in Oceanography*, 1954, **1**, 63-77.
6. Mahadevan, C. and Sriramadas, A., *Ibid.*, 1954, **1**, 57-62.

SURVEY AND CLASSIFICATION OF INDIAN SOILS*

THE prime necessity of present-day Indian agriculture is a well-planned, well-understood and well-carried out programme of soil management in order that the soil would continue to produce satisfactorily in accordance with its capabilities. For this purpose, the necessity for manuring and fertilization, crop rotation as well as appropriate tillage at the right time under the right conditions should receive their full attention.

The deficiency of nitrogen in all Indian soils demands the highest priority to be given to the production and use of nitrogenous fertilizers. Manurial experiments at the State Agricultural Laboratories have indicated vast potentialities of increasing crop production by the use of plant food elements in the form of simple mineral salts. But the cultivators need to be educated by demonstrations and propaganda about the concept of mineral nutrition of plants. Under the Second Five-Year Plan, the Indian Council of Agricultural Research have initiated a model scheme on simple manurial trials on cultivators' fields all over the country.

Soil testing forms an integral part of advisory services offered to farmers inasmuch as specific nutrient deficiencies must be detected and remedied in time in order to maintain productivity of the soil at the optimum level. Twenty-four soil testing laboratories are to be established in different regions of the country for this purpose.

There have been a good number of soil surveys of limited areas with specific objectives such as fertility surveys, pre-irrigation and post-irrigation surveys and genetic surveys. However, the basic knowledge of the soil types which form the physical basis for land use is still incomplete.

Genetical soil studies and classification of soils based on morphology, physical, chemical and mineralogical compositions, are comparatively recent developments in India. Reference may be made to the study of Lateritic and Red soils by Sen and Deb (1941) and Raychaudhuri and co-workers (1941, 1942 and 1944), Kumaon Hill soils at Chaubatia in Uttar Pradesh by Mukherjee and Dass (1940), soils of the canal zones of Bombay-Deccan by Basu and Sirur (1938) and the effect of climate, vegetation and topography on the formation of the soil by Raychaudhuri and Mathur (1954).

In connection with irrigation projects, extensive soil studies have been carried out to determine the water relation of soils and to classify them into those suited and unsuited for irrigation. Soil conservation surveys including soil erosion and land utilization for soil and water conservation have also been attended to in some of the States, like Bombay, Damodar Valley Corporation (Bihar) and Uttar Pradesh. In the light of the information available in India and other countries, a survey procedure suitable for Indian conditions needs also to be evolved. In this connection, a Central Soil Conservation Board has been established, the main functions of which are to organise, coordinate and initiate research in soil conservation, to arrange for the training of technical personnel and rendering financial assistance.

Under the U.S. programme, soil survey is being carried out in forty centres throughout India on soil climate basis. But a great deal of field research is necessary to correlate combinations of soil characteristics as determined by detailed morphological studies in the field, and chemical, physical and mineralogical studies in the laboratory, with the geomorphological characteristics of the landscape and responses of the soils to management. The All-India Soil Survey on a soil-region basis has therefore been planned and four regional centres are proposed to be established.

The first need for soil surveys in India is classification and nomenclature according to carefully defined units of the lower categories. Units need to be based upon both external and internal characteristics of soils as landscapes with special emphasis on detailed morphological studies, using standard methods and terms for describing the individual characteristics. In view of the lack of adequate data on Indian soils, especially morphological data, a real need exists also for a first approximation to the higher categories of classification. Since several countries are directly concerned with well-developed soils in tropical and equatorial regions, the great advantages of international co-operation and agreement on the broad groups and nomenclature of soils in the tropics and equatorial regions are obvious.

* Abstract of the Presidential Address to the Section of Agricultural Sciences, by Dr. S. P. Raychaudhuri at the 43rd Session of the Indian Science Congress, Agra, 1956.

INFERENCE IN TIME SERIES*

By time series is meant data in the form of one or more records of observed magnitudes arranged in order of time. Sometimes we have a continuous record of observations, and at other times the record is a sequence (or sequences) of magnitudes observed at equal intervals of time. These are known respectively as continuous and discrete time series. Geophysical and meteorological time series can be observed over a long period, the annual conditions of weather remaining more or less the same over this long stretch of time. However, time series referring to economic phenomena, are generally short because economic conditions undergo abrupt changes now and then.

The conventional analysis of time series into trend, cyclical part, and the residual, is superficial. Earlier work on time series refers mostly to trend-fitting and periodogram construction. Some tests of significance have already been considered in respect of elimination of trend, significance of harmonic analysis, and autocorrelation. More recently, large sample tests of goodness of fit for auto-regressive and moving average models have also been constructed by a number of workers.

By 1947, time became ripe for the initiation of the classical procedures of statistical inference into time series studies. The work of A. Kolmogoroff (1933) and J. L. Doob (1937) has validated the use of a probability measure in function spaces of time series in a number of cases, if not universally. H. Cramér's spectral representation of stationary processes (1942) and the subsequent work of K. Karhunen (1947) have provided new and powerful tools for the study of time series from the standpoint of stochastic processes.

Frequently, the specification of time series does not go beyond stationarity or the Markoff property. As such, an explicit functional formulation of the likelihood is not possible except in the special cases of processes which are also known to be Gaussian. Thus, maximum likelihood estimation procedure is of limited application in time series studies. The usual criteria of consistency, unbiassedness and minimum variance can, however, be taken over into studies on inference in time series. In 1950, U. Grenander has shown how the concept of the likelihood ratio of Neyman-Pearson theory can be brought over into the study of time series with the help of Radon-Nikodym theorem. He has considered the problem of estimation of the mean value function and of the mean value constant which it takes in the case of stationary processes. In the latter case, the time average of the recorded observations is an unbiassed and asymptotically efficient estimate of the unknown mean value. However, U. Grenander (1950) and K. Nagabhushanam (1952) have shown that it is not necessarily the minimum variance estimate. Optimal estimation is generally found to depend on the solution of an integral equation. K. Nagabhushanam (1951) has obtained an integral equation for optimal prediction of the primary process of a linear relationship which reduces by suitable specialization to Levinson's form of Wiener's integral equation for prediction with filtering.

One of the fascinating fields of study relating to inference in time series is the estimation of the spectrum of a stationary process. The classical periodogram is only an asymptotically unbiassed estimate of the spectral intensity and not a consistent estimate of it. Daniell, U. Grenander, and M. S. Bartlett were led to a consideration of weighted sums of periodogram ordinates for obtaining consistent estimates of the spectral density. The need to enlarge the specification of processes to include the cases of stationary processes whose spectra contain the saltus part also is vital to a spectral study of the problem of search for hidden periodicities. It now appears that this can be done, and we can have a positive line of approach to this classical problem of detection of periodicities in a trend-eliminated stationary time series.

* Abstract of the Presidential Address to the Section of Statistics, by Prof. K. Nagabhushanam, at the 43rd Session of the Indian Science Congress, held at Agra, 1956.

SIR CYRIL HINSHELWOOD

SIR CYRIL HINSHELWOOD, Dr. Lee's Professor of Chemistry in the University of Oxford, has been elected the new President of the Royal Society. Sir Cyril is known internationally both for his researches as a physical chemist, and as Foreign Secretary of the Royal Society since 1950. His researches on complex chemical reactions have thrown new light on fundamental processes in biological systems. He also contributed to the British war-time research programme in chemistry. He has been the recipient of many medals including Davy and Royal Medals.

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UNIT CELL DIMENSIONS AND SPACE GROUP OF COPPER ETHYL SULPHATE

The crystal $Cu(C_2H_5SO_4)_2.4H_2O$ belongs to the orthro-rhombic class, D_{2h}^{15} and crystallizes as long needles when grown rapidly from solution. The axial ratios from Hiordthal's measurements as reported in Groth (*Chemische Kristallographie*, Vol. 3, page 123), are:

$$a : b : c = 0{\cdot}7491 : 1 : 0{\cdot}6744$$

In the present investigation the axes are re-named in order to correspond with the space group listed in the *International Tables*, namely, *Pbca*, to which the crystal belongs. Thus the Groth axes *a*, *b* and *c* are re-named *b*, *a* and *c* respectively.

Using CuK_α radiation, oscillation, rotation pictures and Weissenberg photographs of the zero and higher layers were taken about the *b* and *a* axes. The unit cell dimensions are: $a = 9{\cdot}73$ A, $b = 7{\cdot}30$ A, $c = 19{\cdot}70$ A.

The axial ratios reported in Groth were obtained on the basis of the measurements of only the four interfacial angles $(001) \wedge (111)$, $(010) \wedge (111)$, $(100) \wedge (111)$, $(111) \wedge (11\bar{1})$. The *c* axis obtained from X-ray methods is seen to be thrice the Groth axis, for this alone makes the reported axial ratios possible. Thus the plane which Hiordthal assumed as (111) is actually (331). Assuming its new indices and the unit cell dimensions, the interfacial angles are exactly the same as those measured or calculated by Hiordthal.

The systematic absences in the zero, first and second layer Weissenberg photographs about the *b* axis, and the zero layer picture about the *a* axis are as follows:

hkl none; all present

$0kl$ absent if $k = 2n + 1$;

$h0l$ absent if $l = 2n + 1$;

$hk0$ absent if $h = 2n + 1$;

$h\,0\,0$ absent if $h = 2n+1$;
$0\,k\,0$ absent if $k = 2n+1$;
$0\,0\,l$ absent if $l = 2n+1$.

Therefore, the space group is *Pbca*.

The experimentally determined density is 1·79 g./cm.[3] It was thought necessary to determine the number of water molecules in one molecule of the crystal and a detailed chemical analysis confirmed the composition to be $Cu(C_2H_5SO_4)_2.4\,H_2O$. These data give the number of molecules per unit cell to be four.

Complete structure analysis is in progress. The authors thank Prof. R. S. Krishnan for his kind interest in the work.

Dept. of Physics, S. SWAMINATHAN.
Indian Inst. of Sci., S. R. SIVARAJAN.
Bangalore-3, R. V. G. SUNDARA RAO.
February 14, 1956.

REDUCED TEMPERATURE SCALES

ALTHOUGH the significance of the van der Waals reduced temperature T/T_c is well understood, there appears to be some confusion regarding the so-called reduced temperatures proposed by Bauer, Magat and Surdin[1] and by Sibaiya and Rao.[2]

For the purpose of expressing the variation of surface tension with temperature, the latter investigators assume that the Lindemann formula is applicable to a liquid at any temperature and may thus be combined with the Eötvös equation to give

$$\gamma = \gamma_f \left(\frac{V_f}{V}\right)^{\frac{2}{3}} \left(\frac{T_c - T}{T_c - T_f}\right) = \gamma_f \left(\frac{V_f}{V}\right)^{\frac{2}{3}} \theta' \quad (1)$$

where γ and γ_f are the surface tensions at temperature T and freezing point T_f, respectively, V and V_f are the corresponding molar volumes, and T_c is the critical temperature of the substance. Such an assumption, however, is unnecessary inasmuch as division of the Eötvös equation for the system at the temperature T

$$\gamma V^{\frac{2}{3}} = k\,(T_c - T)$$

by that for the system at the freezing point T_f

$$\gamma_f V_f^{\frac{2}{3}} = k\,(T_c - T_f)$$

yields (1) directly. It may be noted that the function assumes all values between 1 and 0 as the temperature is raised from T_f to T_c.

The reduced temperature proposed by Bauer, Magat and Surdin is defined by

$$\theta = \frac{T - T_f}{T_c - T_f}$$

where T_f is the melting point, or more correctly, the temperature corresponding to the triple point. Although Scott and Dillon[3] state that "L. Sibaiya and M. R. Rao have also hit upon the idea of the reduced temperature θ," it is now evident that the relation between the two functions is

$$\theta = 1 - \theta'.$$

Scott and Dillon point out that it should be possible to invent other reduced temperature scales but that "no such scale for liquids would have the same general significance or usefulness as the θ-scale of Bauer, Magat and Surdin". It may be shown, however, that the scale retains its essential significance when T_f is replaced by an arbitrary temperature. Thus the value of a particular property P (such as orthobaric density difference, surface tension, heat of vaporisation[4]) may be expressed by a power law of the type

$$P = P_0\,(1 - T/T_c)^n$$

where P_0 is a specific constant and n is very nearly a general constant for non-associated liquids. If P_1 is the value of the property at the temperature T_1, then

$$P = P_1 \left(\frac{T_c - T}{T_c - T_1}\right)^n.$$

Since

$$T_c - T_1 = (T_c - T) + (T - T_1),$$

we have

$$P = P_1 \left(1 - \frac{T - T_1}{T_c - T_1}\right)^n$$

which is of the same form as the equation of Bauer, Magat and Surdin. Since T_1 may take any value below T_c, it is evident that we may set up any number of such functions with the same general significance inasmuch as their use in this way reveals the same underlying attribute of the system. Moreover, from the standpoint of general utility the above formulation has the advantage that the second reference temperature need not be the freezing point (where, apart from the difficulties attending the experimental measurements, the internal structure of the liquid may be different from that at higher temperatures), but the temperature at which the particular pro-

perty may be measured with the highest precision.

Chemistry Dept., S. T. Bowden.
University College, Cardiff,
Wales, *December* 1, 1955.

1. Bauer, E., Magat, M. and Surdin, M., *Trans. Faraday Soc.*, 1937, **33**, 81.
2. Sibiaya, L. and Rao, M. R., *Curr. Sci.*, 1939, **8**, 359.
3. Scott. A. F. and Dillon, R., *J. Chem. Physics*, 1949, **17**, 1179.
4. Jones, W. J. and Bowden, S. T., *Phil. Mag.*, 1946, [7], **36**, 480.

ON THE GRAVITATIONAL FIELD OF DISTANT ROTATING MASSES

In a recent paper, Bass and Pirani[1] have discussed corrections to Thirring's calculations of the gravitational field near the centre of a rotating spherical shell by introducing an additional term $E^{\mu\nu}$ representing the elastic interaction between particles of the shell, in the expression for the energy-momentum tensor $T^{\mu\nu}$. It is felt by the authors that, as a matter of fact, when $T^{\mu\nu}$ is expressed as

$$T^{\mu\nu} = (\rho + 3p)\, v^\mu v^\nu - p g^{\mu\nu} \qquad (1)$$

then, there is no necessity of introducing any additional term $E^{\mu\nu}$ as the results can be obtained by the usual process of transformation from the Galilean to non-Galilean system of

$$-KT_{\mu\nu} = \begin{pmatrix} 2m\sin^2\theta\{\omega^2+r^2\times(\omega\ddot{\omega}+\dot{\omega}^2)\} & 0 \\ 0 & -2mr^2\sin^2\theta\{\omega^2-r^2\times(\omega\ddot{\omega}+\dot{\omega}^2)\} \\ 0 & 0 \\ 2mr\sin^2\theta\omega\dot{\omega} & 3mr^2\sin\theta\cos\theta\,\omega\dot{\omega} \end{pmatrix}$$

co-ordinates, as a result of which relation (1) is obtained.

It may be considered that the metric tensor $g_{\mu\nu}$ in the non-Galilean co-ordinate system differs only slightly from its Galilean value. We may, therefore, express the metric as

$$ds^2 = -(1-\alpha)\,(dr^2+r^2d\theta^2+r^2\sin^2\theta\,d\phi^2) + (1+\alpha)\,dt^2 \qquad (2)$$

where α is a function of r, θ and t and is an infinitesimal of the first order. Its variations with respect to r, θ, t are also very small, so that we may neglect their products in the expression for T_ν^μ. We may then write T_ν^μ correct to the first order, as

$$-KT_\nu^\mu = \begin{pmatrix} \frac{\partial^2\alpha}{\partial t^2} & 0 & 0 & 0 \\ 0 & \frac{\partial^2\alpha}{\partial t^2} & & \frac{\cot\theta}{2r^2}\cdot\frac{\partial\alpha}{\partial t} \\ 0 & 0 & \frac{\partial^2\alpha}{\partial t^2} & 0 \\ 0 & \frac{\cot\theta}{2}\cdot\frac{\partial\alpha}{\partial t} & 0 & 0 \end{pmatrix} \qquad (3)$$

where

$$\frac{\partial\alpha}{\partial t} = 2R_0^2\sin^2\theta\chi^3\Omega\dot{\Omega},$$

$$\frac{\partial^2\alpha}{\partial t^2} = 2R_0^2\sin^2\theta\chi^4\{\Omega\ddot{\Omega}+\Omega^2\chi^2(1+3R_0^2\sin^2\theta\Omega^2)\},$$

$\alpha = 4\chi^2 +$ constant and

$$\chi = (1-R_0^2\Omega^2\sin^2\theta)^{-\frac{1}{2}}.$$

The density has a zero value as a first approximation.

If, however, we consider

$$T_2^1 = T_1^2 = 0,$$

then, we get

$$\alpha = m(1 - r^2\omega^2\sin^2\theta) \qquad (4)$$

where m is an infinitesimal constant and ω may be considered as the angular velocity. The effect of the rotating shell at any point of interest near the centre is given by

$$\begin{pmatrix} 0 & 2mr\sin^2\theta\,\omega\dot{\omega} \\ 0 & 3mr^2\sin\theta\cos\theta\,\omega\dot{\omega} \\ -2mr^2\sin^4\theta\{\omega^2-r^2\times(\omega\ddot{\omega}+\dot{\omega}^2)\} & 0 \\ 0 & 2m\{\omega^2+r^2\sin^2\theta\times(\omega\ddot{\omega}+\dot{\omega}^2)\} \end{pmatrix} \qquad (5)$$

Other details have been worked out in a paper which is being communicated for publication elsewhere.

Meteorological Office, D. N. Moghe.
College of Engineering, R. V. Wagh.
Poona-5, *December* 21, 1955.

1. Bass and Pirani, *Phil. Mag.*, 1955, **46**, 850.

ON THE SO-CALLED "*MACROCEPHALUS*" BEDS OF KUTCH

JUDGING from the Jumara section,[1] roughly the middle and lower 'Chari' (now known as Habo[6]) series comprise what have been called by Spath the "*macrocephalus* beds". The age of these beds is debatable. In an earlier communication,[6] several species, *e.g.*, *Macrocephalites chariensis, Indocephalites diadematus, Ceromyopsis aff. striata*, etc., have been shown to favour a Callovian age for them. Some additional observations and facts regarding certain occurrences and stratigraphy of these beds are put forward in the present note.

In the North-Western Kutch, these beds are known to be missing from the outcrops of Habo [Chari] series to the south of Bhuj. To the north of this town they occur towards the centre of the denuded Habo, Jhura, Jumara domes, etc. (for different localities see Raj Nath[7]). Spath is mistaken in stating that one of the "outcrop(s) of the *macrocephalus* beds is on Khera (= Keera) Hill near Chari....". Correctly speaking the Habo beds do not outcrop at all on the Keera Hill proper, which is an 'intrusive peak'. It is to the south of that 'trap hill' that one gets a quaquaversal arrangement of the Habo beds, forming Keera dome of Raj Nath.

Macrocephalitids, in general, are the dominant ammonites in these beds of Kutch and, according to Spath, "most of them are types such as occur in the English Cornbrash, even if there are no species in common". Numerous species of them have been recorded,[2] but *Macrocephalites macrocephalus* is yet unknown from this richly fossiliferous region of India. It is, therefore, very doubtful whether the use of this species as zonal index is justified for this area.

Spath further subdivides these Kutch beds into lower, middle and upper subdivisions. He finds, for one or the other reason, different Kutch species objectionable to serve as index-ammonites for these three horizons. Subsequently, he chose[3] two European species, *Kamptokephalites herveyi* and *Pleurocephalites tumidus*, to denote the middle and upper subdivisions respectively; and a Kutch form, *M. triangularis*, for lower horizon. This choice of *triangularis* is very unsatisfactory, since that species is not confined to lower *macrocephalus* beds but extends below into the Patcham beds also,[4] and only two examples of it have been recorded from Kutch. Moreover, the precise horizon of the holotype of *triangularis*, in Blake Collection in the British Museum (Natural History), is uncertain. It came from 'bed 13 or 14 *a*' of Jumara. In view of the correlation given by Spath, these two beds belong to two different groups; the former constitutes his lower *macrocephalus* beds ("Upper Bathonian"), whilst the latter is, evidently, to be included in the Patcham group ("Lower Bathonian"), although that author made no mention of this bed (14 *a*) in his Jumara succession table.

P. tumidus is a Callovian form according to Spath himself, as pointed out in an earlier note[6] yet that ammonite specialist has included the 'upper *macrocephalus* beds' of Kutch in Upper Bathonian.[5] *K. herveyi* is a widespread Upper Cornbrash species. The Upper Cornbrash with *Macrocephalites* is quite distinct from the lower with *Clydoniceras*.[8] The faunal differences between these two divisions are of major importance. "The Lower or zone of *Clydoniceras discus* is Bathonian; the Upper or zone of *Macrocephalites macrocephalus* (auct.) is Callovian."[9] Hébert,[10] too, pointed out that *macrocephalus* and *herveyi* occur only in Callovian.

The lower Habo series of Jhura Hill has now yielded to me a well-preserved young example of *Camptonectes auritus* [*lens*]. Although this species has been recorded by some authors from Bajocian, Arkell has shown that in England, at least, it ranges from Upper Cornbrash onwards. In Kutch it is now known to range from lower Habo series upwards.

Lastly, Blake's "*Nucula* flags" of West Badi, belonging to "*macrocephalus* beds" (see Agrawal, *loc. cit.*), yielded to Blake an *Obtusicostites*—a genus ordinarily considered as Callovian. This occurrence, though needing confirmation by further collection, however, lends support for their Callovian age.

Laboratoire de Paléontologie, S. K. AGRAWAL.
Muséum national d'Histoire naturelle,
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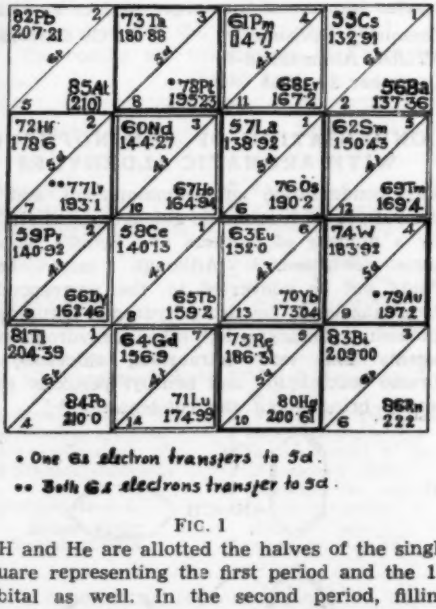
PERIODIC CLASSIFICATION AND ELECTRONIC CONFIGURATION OF ELEMENTS

THE arrangement of elements shown in Fig. 1 is intended to indicate periodicity as well as the electronic configuration (in the outer shells). A system of squares is adopted, and the tabulation of one period (the VIth) is given in full. Each square representing a period is divided into smaller squares, four for periods II and III, nine for IV and V, and sixteen for VI and VII. Each element is allotted one half of a square. The advantages of this allocation are: (1) The number of half squares corresponds to the number of elements in each period, 2, 8, 8, 18, 18, 32, 32. (2) Each square represents one orbital and therefore the half squares correspond to two electrons of opposite spins belonging to the same orbital. The division of each square into two follows the Pauli principle.



* One 6s electron transfers to 5d.

** Both 6s electrons transfer to 5d.

FIG. 1

H and He are allotted the halves of the single square representing the first period and the 1*s* orbital as well. In the second period, filling up of the electrons in the orbitals is done according to Hund's law[1] of maximum parallel spins, *i.e.*, one electron is allotted to each of the *p* orbitals before the second one is added.

On further expansion to nine squares, the same order of filling up is followed, so that the typical elements occupy the same corner squares as in the previous periods. Thus periodicity also is shown. The remaining five squares accommodate the ten transitional elements.

Following the same order of filling up (i.e., beginning diagonally from the top right-hand corner) after filling the upper half of the next square ($5d^1$, lanthanum) one passes on to the next square which represents a $4f$ orbital. Then seven additional squares (enclosed by double lines) are filled up by the rare earth elements before the remaining 5*d* squares (enclosed by bold lines) are taken up. Thus the corner squares are left vacant for the typical elements. The transitional elements occupy corresponding positions in the expanded squares too. The arrangement in the last period is similar.

The recent publications of Ganesan[2] and Ramirez-Torres[3] have been of considerable help in drawing up this scheme.

Dept. of Chemistry, K. K. SUGATHAN.
Sree Kerala Varma College, T. C. K. MENON.
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ADSORPTION OF IODINE ON CELLULOSE FROM ORGANIC SOLVENTS

IN adsorption from solution, the interaction between the solvent and the adsorbent plays an important part. A further complication is introduced if the solvent has a swelling action on the adsorbent as is frequently the case with cellulose. It was thought that the two effects can be separated by swelling the cellulose to the same extent in each case. This may be done by allowing the cellulose to swell in water, replacing water by a water-miscible organic solvent such as acetone or methanol, and then this may be replaced by the organic solvent to be studied. In this way, adsorption isotherms of iodine in benzene and in methanol solutions were obtained for viscose staple fibre. Isotherms were also obtained on unswollen viscose for the sake of comparison.

The experimental procedures for unswollen and swollen viscose were as follows: (*a*) *Unswollen Viscose*: 30 ml. of the iodine solution of known concentration were added to about 0·3 g. of dry viscose fibre in a 100 ml. glass-stoppered flask, kept at 30° C. for 2 hours with frequent shaking, and the equilibrium concentration measured by withdrawing a sample of the

solution and titrating against sodium thiosulphate of appropriate strength. (b) *Swollen viscose*: About 0·3 g. of viscose (on dry basis) was swollen by keeping immersed in water for about 1 hour. The water was removed by washing the material 4-5 times with acetone, and the acetone was then replaced by the solvent to be used. The loose plug of viscose containing the solvent was weighed to obtain the weight of the solvent held. A suitable correction was then applied for the dilution produced by this amount of the solvent. The remaining procedure, however, was same as for the unswollen viscose. The results are presented in Fig. 1.

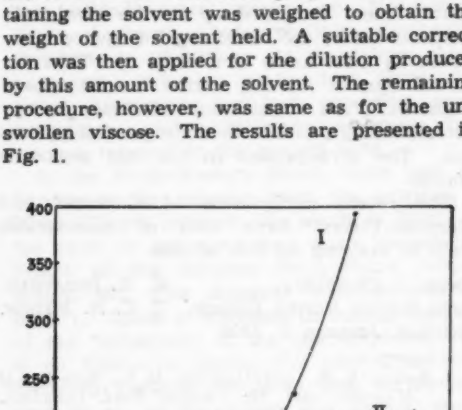


FIG. 1. *x*-Axis—Concentration of the iodine solution in g. per 100 ml.; *y*-Axis—Adsorption expressed as mg. of iodine per g. of viscose; I—from methanol on swollen viscose; II—from benzene on swollen viscose; III—from benzene on unswollen viscose; IV—from methanol on unswollen viscose.

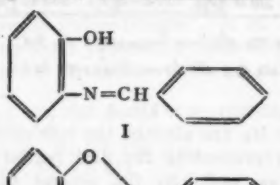
All the isotherms give sigmoid curves and not the familiar curves obeying Freundlich equation. This indicates that multimolecular adsorption is present. On comparing curves III and IV for unswollen viscose, one finds that the adsorption is greater from benzene than from methanol. At first this seems surprising because methanol is known to have a much stronger swelling action than benzene and so it should make larger surface area available for adsorption. But if one considers the hydroxyl groups in cellulose as mainly responsible for adsorption, then one can see that many of them will form hydrogen bonds with methanol and thus may not be available for adsorbing iodine. This of course will not happen in benzene solution. Moreover, although benzene as such has little swelling action on cellulose, a strong solution of iodine in benzene may exert some swelling action. As a matter of fact, during the study of adsorption on swollen viscose, the sample which was in the form of a plug was found to disintegrate in the stronger iodine solutions.

On the above hypothesis, the adsorption from benzene should be greater than that from methanol on the swollen viscose too; but actually from curves I and II, it is found not to be so. This may be explained in the following way. During the solvent exchange, the surface area does not remain constant and a certain amount of deswelling takes place when benzene is used as the final solvent. It is reasonable to expect that this will not happen with methanol. Thus the cellulose does not remain swollen to the same extent and so the adsorption from methanol turns out to be greater because of the larger surface available.

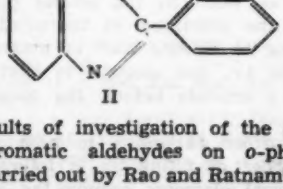
Chemistry Division, A. G. CHITALE.
ATIRA, Ahmedabad-9,
December 24, 1955.

CONDENSATION OF *o*-AMINOPHENOL WITH AROMATIC ALDEHYDES

THE condensation of *o*-aminophenol and its derivatives with aromatic aldehydes was studied by a number of workers and Schiff's bases I were obtained.[1-3] Although these bases could not be converted to the corresponding benzoxazoles II by using hydrogen peroxide or potassium ferricyanide,[4] other dehydrogenating agents like lead tetracetate, chloranil, N-bromo succinimide and benzoyl peroxide could easily bring about the condensation.[5-7]



I



II

The results of investigation of the action of certain aromatic aldehydes on *o*-phenylenediamine carried out by Rao and Ratnam[8] in these laboratories prompted us to reinvestigate the condensation of some aromatic aldehydes with

o-aminophenol under varying conditions. During these investigations, nitrobenzene was found to be a very effective condensing agent resulting in the formation of benzoxazoles without the necessity of adding any oxidising agent. The yields of benzoxazoles were found to be uniformly good when equimolecular proportions of *o*-aminophenol and the aldehydes were refluxed in nitrobenzene medium for one and a half hours. The benzoxazoles could be isolated in some cases by steam distillation of the reaction mixture, nitrobenzene and the unreacted aldehydes distilling at first. In other cases, the solution, remaining after steam distillation of nitrobenzene and the unreacted aldehyde, was worked up to isolate the benzoxazole.

In all, fourteen aromatic aldehydes have been condensed with *o*-aminophenol, of which the reaction with the following six aldehydes, *p*-hydroxy benzaldehyde, vanillin, 3 : 4-dichlorobenzaldehyde, *p*-bromobenzaldehyde, 5-nitrosalicylaldehyde and α-naphthaldehyde, has been studied for the first time.

The results are summarised in Table I.

TABLE I

Aldehyde condensed	Benzoxazole
Benzaldehyde	2-phenyl- (*a*)
Salicylaldehyde	2-(*o*-hydroxyphenyl- (*a*)
p-Hydroxybenzaldehyde	2-(*p*-hydroxyphenyl)-* (*b*) m.p. 253°
Vanillin	2-(3'-methoxy-4'-hydroxyphenyl)-* (*b*) m.p. 166°
Anisaldehyde	2-(*p*-methoxyphenyl)- (*b*)
Piperonal	2-(3',4'-methylene-dioxyphenyl)- (*a*)
p-Chlorobenzaldehyde	2-(*p*-chlorophenyl)- (*a*)
3 : 4-Dichlorobenzaldehyde	2-(3',4'-dichlorophenyl)* (*a*) m.p. 144°
p-Bromobenzaldehyde	2-(*p*-bromophenyl)- ‡ (*a*)
m-Nitrobenzaldehyde	2-(*m*-nitrophenyl)- (*c*)
p-Nitrobenzaldehyde	2-(*p*-nitrophenyl)- † (*c*)
5-Nitrosalicylaldehyde	2-(2'-hydroxy-5'-nitrophenyl)-* (*a*) m.p. 191°
p-Dimethylaminobenzaldehyde	2-(*p*-dimethyl aminophenyl)- (*a*)
α-Naphthaldehyde	2-(α-naphthyl)-‡ (*b*)

* Compounds so far not reported in literature; † Schiff's base was also isolated along with the benzoxazole; ‡ Compounds prepared earlier by different methods.

Method of Isolation :—(*a*) Steam distillation; (*b*) Residue crystallised from ethyl alcohol; (*c*) Residue crystallised from xylene.

Dept. of Chemistry, Osmania University, Hyderabad (Dn.), *December* 15, 1955.

V. V. SOMAYAJULU.
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ARRANGEMENT OF AFFERENT BRANCHIAL ARTERIES IN *ANABAS TESTUDINEUS*

CARTER AND BEADLE[1] AND DAS[2] observed that the arterial supply of the blood in the air-breathing fishes is not of any special interest and very little attention has been given to the adaptive modifications in the afferent branchial arteries in fresh-water fishes, except by Das and Saxena,[3] Saxena,[4] and Das and Saxena.[5] Although a good deal of work has been done on the air-breathing habit and the accessory respiratory organs of *Anabas testudineus*, no account of the modifications of the circulatory system due to air-breathing habit exists.

The present work appears to be the first account of the afferent branchial arteries in *Anabas testudineus* Bloch (Perciformes; Anabantoidei; Anabantidæ). The ventral aorta extends from the ventral end of the third branchial arch upto the mid-distance between the second and first branchial arches where it terminates by bifurcating into the first pair of afferent arteries (Fig. 1). Along its course in

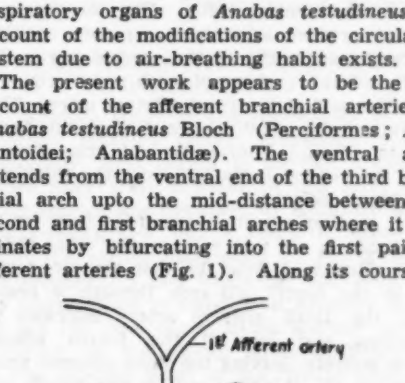

FIG. 1. Afferent branchial arteries in *Anabas testudineus*.

level with the ventral end of the second branchial arch, the ventral aorta gives off the second pair of afferent arteries. Just after piercing the pericardium a little anterior to the ventral

end of the third branchial arch, the third pair of afferent arteries originates from the ventral aorta. After a short distance of its origin the third afferent artery of each side gives rise from its dorsal aspect to the fourth afferent artery which is smaller than the former. The fourth afferent artery runs vertical to the third afferent artery for some distance before it curves posteriorly to supply the fourth gill-arch.

The second pair of afferent arteries (Fig. 2) originates from a single aperture in the dorsal

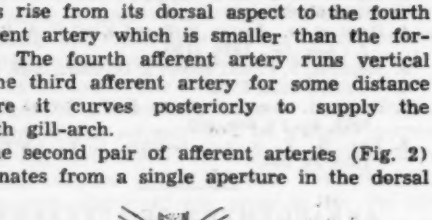

FIG. 2. A part of the ventral aorta and the third afferent branchial artery cut open to expose the origin of the second and fourth afferent arteries.

wall of the ventral aorta. The third pair of afferent arteries arise from separate openings in the lateral walls of the ventral aorta. The fourth afferent artery of each side originates from the roof of the third afferent artery. Thus the remarkable condition exists that the fourth pair of afferent arteries do not arise directly from the ventral aorta but from the third pair of afferent arteries.

The peculiar condition (recorded here for the first time) is not met with in any other Teleostomi (Berg.). It may be that the blood supply to the fourth gill-arch through a branch from the third afferent artery indicates the reduction and loss of the fourth afferent artery entirely, leaving the third afferent artery to supply the third as well as the fourth gill-arches. It is possible that this peculiar arrangement is correlated with the reduction of the fourth gill-arch. My sincere thanks are due to Dr. S. M. Das for his valuable guidance during the present investigations.

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The University, Lucknow,
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THE TONOPLAST IN YEAST

IN deference to the then current belief that meristematic cells are bereft of vacuoles, deVries suggested[1,2] that vacuoles may be represented in meristematic cells by plastid-like primordia. To these he gave the name "tonoplasts". Guilliermond[2] concludes that in the embryonic cells of most plants the vacuolar system or vacuome exists in the form of minute inclusions (p. 220). According to deVries the tonoplasts enlarge by absorbing water. The formation of vacuoles is intimately related to tissue differentiation as well as secretory phenomena. Since vacuoles were conceived to originate from tonoplasts, the term tonoplast came finally to refer to the vacuolar membrane[1] (p. 19).

Guilliermond illustrates the appearance of yeast cells when examined under dark ground illumination. He remarks that only infrequently could the vacuole be made out by its luminous contour[2] (cell 4, Fig. 110, p. 165). Usually it is said to be invisible and could be located only by the luminous lipid particles surrounding it.

Examination of a 72-120 hr. culture of our control yeast strain, BY 1, in a galactose-

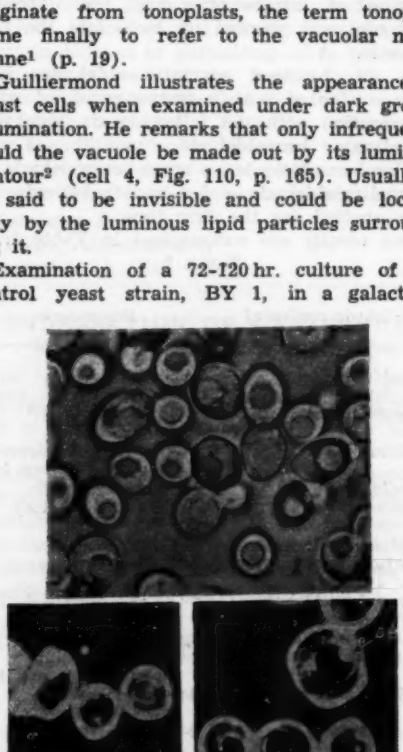

FIG. 1. Yeast cells from a 72-hr. culture. Light microscope.

FIG. 2. Cells from a 120-hr. culture. Dark ground illumination.

FIG. 3. Cells from a 12-day old culture. Dark ground illumination.

VM–Vacuolar Membrane; DB–Dancing Body

peptone-yeast extract medium shows the majority of cells to be vacuolated (Fig. 1). But when the same cells are observed under dark ground illumination, only in a few does the vacuole stand out by its luminous contour (Fig. 2). This engendered the suspicion that the vacuoles of older cells alone may have a definite membrane. Therefore, the cells mounted in the growth medium and sealed with paraffin were studied after the lapse of 7 days. The vacuoles in most cells had a luminous contour (Fig. 3). As will be seen, some of the cells have more than one vacuole.

A single grain, the 'dancing body', is present in most of the vacuoles (Fig. 3, DB) and since it is in active Brownian movement it is very difficult to photograph it. The limits of the vacuole lacking a luminous contour could often be surmised by the range of movement of the dancing body. Under the light microscope the dancing body is as clear as the vacuole in which it is present. Since often the dancing body alone is seen under the dark ground illumination one has to presume that only formed structures in cells are visible under this type of illumination.[3] Hence, when the dancing body is seen in a vacuole having a luminous contour (Fig. 3), it has to be surmised that there is a formed membrane delimiting the vacuole from the cytoplasm.

Can the vacuolar membrane of yeast be considered homologous to the tonoplasts of plant cells ?

I am very grateful to Dr. M. K. Subramaniam for his guidance and encouragement.

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Dept. of Biochemistry,
Indian Inst. of Science,
Bangalore-3, *February* 9, 1956.

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RELATIONSHIP BETWEEN FLOWERING AGE AND HEIGHT IN *SACCHARUM SPONTANEUM* LINN.

While recording growth observations of wild *Saccharums* for the study of their desirable attributes with a view ultimately to use them as good progenitors of commercial canes, it was found that smaller forms of *S. spontaneum* flowered earlier in season while tall ones arrowed towards the end. The correlation coefficient between height of plant and number of days after germination to flowering was as high as + 0·94, the total number of pairs of observations being 17. The regression coefficient for the two was $Y = 105{\cdot}71 + 0{\cdot}292\,X$, where X is the average height of plant in cm. and Y the number of days. In other words, an increase in the height of plant by 1 cm. over a base line of 105·71 cm. will delay flowering by 0·292 days. No correlation was found to exist between the time of flowering and relative growth rates of the different forms as calculated by Heath's formula[1] ($H = Ae^{bt}$ where H is final height attained; A is the length attained by an initial time; *e* is the base of natural logarithm; *b* is the index of 'efficiency of plant as producer of new material'; and *t* is the time).

Grateful thanks are due to Sri. K. L. Khanna for kindly providing facilities for this work.

Central Sugarcane Res. Station, Pusa, Bihar, *July* 12, 1955.

S. L. Sharma.
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M. N. Alam.
J. P. Trivedi.

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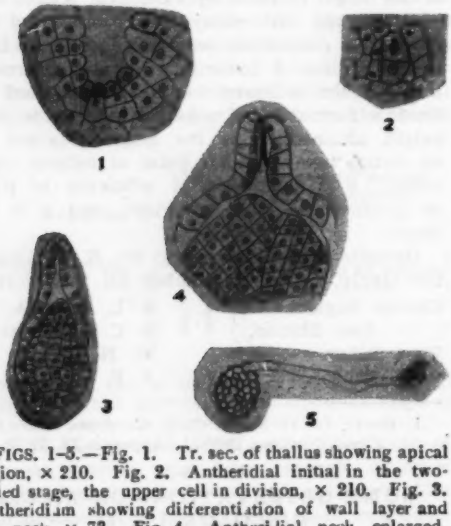
SOME OBSERVATIONS ON *RICCIA DISCOLOR* L & L.

A detailed study of the life-history of *Riccia discolor* revealed certain interesting features, especially with regard to the sex organs and these have been included in this short paper. This species was described by Kashyap[1] as *Riccia himalayensis* but it seems to agree fully with the earlier description of *Riccia discolor* by Stephani,[2] a fact which has also been noted by Chopra[3] and by Pande and Ahmed.[4] In view of this the older name, *Riccia discolor* has been retained for the species under investigation.

The growing point of the thallus appears to be made of more than one cell, probably a row of two or more cells (Fig. 1). The development of the air-spaces is by the schizogenous method.

In this monœcious species, the archegonia are the first to appear followed later by the antheridia. The antheridia have, curiously enough, a small neck-like structure traversed by a canal. While the antheridial initials are dividing, the cells immediately surrounding them become distinct from the others with their rich contents and divide rapidly to form a conspicuous neck with several tiers of cells (Figs. 2, 3) almost comparable to the archegonial neck. The archegonial neck is, however, formed by the archegonial initial, while the neck-line structure

seen in the antheridium here is built up of the surrounding vegetative cells. It is very likely that the sperms are discharged through the canal which runs through the neck and connects the antheridial cavity with the exterior (Fig. 4). This is further supported by the observations that empty antheridia invariably show the neck split up, suggesting that the sperms have been discharged along this canal. A neck, like the one described above, has been noticed by Black[5] in *Riccia frostii* but he does not comment further on it. Cavers[6] also figured such a neck in *Riccia glaucecens* but did not describe it.



FIGS. 1–5.—Fig. 1. Tr. sec. of thallus showing apical region, × 210. Fig. 2. Antheridial initial in the two-celled stage, the upper cell in division, × 210. Fig. 3. Antheridium showing differentiation of wall layer and the neck, × 73. Fig. 4. Antheridial neck enlarged, × 73. Fig. 5. Germinating spore with germ tube, × 106.

The development of the embryo is similar to that described for other species and as observed by Srinivasan,[7] some of the spore mother cells degenerate during spore formation. It was also noticed that when more than four or five sporphytes are borne on the same thallus, some of them degenerate, perhaps, due to lack of sufficient nourishment. Spores could be successfully germinated (Fig. 5) during the months April and May, in natural conditions and in soil solutions. Spore germination has not been previously reported in this species.

The haploid number of chromosomes is 8, one of the chromosomes being very small. This is in conformity with the previous observation of Mahabale and Gorji.[8]

My grateful thanks are due to Prof. L. N. Rao, at whose suggestion and under whose guidance this work was done in the Department of Botany, Central College, Bangalore.

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EFFECTS OF TOTAL BODY X-RAY IRRADIATION ON THE LEVELS OF TRYPTOPHANE AND NICOTINIC ACID IN LIVER AND KIDNEY OF RATS

THE extreme radiosensitivity of tryptophane[1,2] in *in vitro* experiments, as also the duel role it has to play in the body as a constituent of a protein and as a precursor[3,4] of vitamin nicotinic acid prompted us to investigate the influence of the total body irradiation on the metabolism of tryptophane and its conversion to nicotinic acid. Normal metabolism of tryptophane is sufficiently well known[7,8] and need not be repeated here. Suffice it to say that the tryptophane first gets converted to an intermediate metabolite by the mediation of an enzyme trytophane peroxidase[5,6] in presence of H_2O_2, followed by the oxidation of the intermediate to formylkynurenine.[5,6] Formylkynurenine is then metabolized through a number of intermediates to nicotinic acid.[3,4] Thomson and Mikuta's[9] demonstration of increased tryptophane peroxidase-oxidase activity in irradiated animals, coupled with the evidence of formation of free radicals like HO_2, H_2O_2 after irradiation might facilitate a greater conversion of tryptophane to nicotinic acid. This aspect has been studied and is being reported in this communication.

Wistar rats 2-3 months old weighing between 200-50 g. were divided into 6 groups, each group consisting of 6 animals. One group served as a control whereas the animals from other groups were sacrificed at the intervals of 2, 4, 6, 24 and 48 hours after irradiation. All animals except controls were irradiated with 250 KV Westinghouse machine using 1 mm. Al and 0·5 mm. Cu as filters at the rate of 45 *r* per minute. The animals were exposed to L D 50 dose of total body irradiation of 600 *r* each. Animals were sacrificed by dislocation of cervicle vertebræ at the intervals specified

TABLE I

Effects of total body X-irradiation on tryptophane and nicotinic acid levels of rat tissue

Group	No. of animals	Amount of Tryptophane		Amount of Nicotinic acid	
		Liver	Kidney	Liver	Kidney
		mg./g. of tissue	mg./g. of tissue	µg./g. of tissue	µg /g of tissue
Control	6	1·961 ±0·085	1·871 ±0·055	126·5 ±3·03	77·81 ±3·02
2 hours after irradiation	6	2·059 ±0·110	1·929 ±0·078	110·0 ±3·99	89·75 ±3·22
4 do	6	1·717 ±0·09	1·778 ±0·130	121·5 ±1·55	85·25 ±1·10
6 do	6	1·730 ±0·038	1·797 ±0·030	119·5 ±1·70	93·62 ±1·52
24 do	6	1·644 ±0·044	1·327 ±0·028	182·4 ±6·26	121·65 ±2·31
48 do	6	1·451 ±0·038	1·380 ±0·066	191·66 ±6·28	131·66 ±7·78

The standard errors have been calculated using the fomula S. E $= \sqrt{\Sigma d^2/n\,(n-1)}$

above. Livers and kidneys were immediately dissected out, blotted free of blood and assayed for tryptophane and nicotinic acid by the procedures outlined below.

For the assay of tryptophane the homogenized tissues were refluxed with 5 N NaOH for 20 hours, whereas for the assay of nicotinic acid the homogenates were autoclaved for 30 minutes at 15 lb. pressure with 1 N H_2SO_4. In both the cases the hydrolysates were adjusted to pH 4·5 and stored in refrigerator (4° C.) under a layer of toluene until assayed by microbiological methods. The microbiological assay of nicotinic acid was carried out with *L. arabinosus* 17/5 by a procedure essentially the same as described by Barton-Wright.[10] Tryptophane was estimated by using the same organism according to the method of Barton-Wright.[11]

The results of tryptophane and nicotinic acid levels in livers and kidneys at different intervals of time after irradiation are given in Table I.

It will be seen from the table that the tryptophane and nicotinic acid levels do not seem to vary very significantly from that of normal control animals at 2, 4 and 6 hours after irradiation. However, the effects become pronounced at 24 hours and 48 hours, there being a diminution in tryptophane levels to the extent of 16 and 26% in the livers, and 29 and 26% in the kidneys. Concurrently there is a 45 and 58% increase in the nicotinic acid levels in the livers at 24 and 48 hour groups respectively. The nicotinic acid levels in kidneys are comparatively high and range from 54 and 69% at these intervals respectively. It has been noticed, however, that there is no definite ratio between the decrease in tryptophane and increase in nicotinic acid in both liver and kidney, and this may be attributed to the radiolability of tryptophane, and to the possible existence of different pathways of tryptophane catabolism. It is premature at this stage to implicate the siginificance of higher levels of nicotinic acid in irradiated animals, but it would be pertinent to point out that the excess of nicotinic acid has been known to immobilise available methyl groups in the formation of N-methyl derivatives and thus induce fatty livers.[12,13] The demonstration of fatty livers in irradiated rats, which has been reported by earlier works[14,15] assumes greater significance in the light of our own observation on the decrease of methionine and choline levels in such animals.[16]

Further work in this line is in progress.

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OCCURRENCE OF *CORYNEBACTERIUM RENALE* IN GOATS

A SPECIFIC cystitis and pyelonephritis of cattle due to *C. renale* is reported to be fairly prevalent in Europe and America. In India also, the diptheroid has been isolated recently from a case of pyelonephritis in a cow and from a large number of urine samples collected from cases of bovine hæmaturia.[1,2] The organism has also been recovered in several countries from the purulent infections of the urinary tract of sheep, horses, swine and dogs, but no record of its isolation from goats has been found in available literature.

The object of this note is to record the occurrence in goats of a *Corynebacterium* indistinguishable from *C. renale* in its morphological, cultural, biochemical and pathological characters. For the first time, *C. renale* was isolated during routine bacteriological examination of kidneys collected from a case of bilateral pyæmic nephritis. This led us to investigate the carrier rate, if any, of this diptheroid in goats and the role it might play in the pathogenesis of the infections of the urinary tract.

Bacteriological examination was carried out on 50 samples of urine collected from a flock of apparently healthy goats and also on kidneys of 25 goats slaughtered at Mukteswar for meat purposes. *C. renale* could be isolated from two samples of urine as well as from the pyelus of the kidneys of two of the slaughtered goats. On histological examination, all the four kidneys showed normal appearance.

Although *C. renale* has been recognized to be responsible for conditions like pyelonephritis, cystitis, etc., in cattle, the exact role of this diptheroid in the pathogenesis of such conditions is not clearly understood. This organism has been isolated not only from diseased cattle, but also from a large number of apparently healthy animals. Jones and Little[3] recorded its isolation from the mucous membrane of the vagina of a healthy calf. Lovell[4] recovered it from the urine of a cow which appeared normal but was in a herd in which pyelonephritis was known to occur. Morgan *et al.*,[5] and Ruebke[6] described its occurrence in the normal male genitalia of cattle. Weitz[7] found that this organism was a frequent and possibly a normal inhabitant of the posterior urinary tract of apparently healthy dairy cows. Morse[8] could isolate *C. renale* from the urine of 17·6% of 523 apparently normal dairy cattle. In our present studies also, *C. renale* has been recovered from a case of pyæmic nephritis in a goat as well as from the urine samples and the kidneys of healthy goats. These findings may help to solve the enigma of the pathogenesis of specific types of pyelonephritis, cystitis, etc., not only in cattle but also in other species of animals.

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NEW SPECIES OF MARINE BACTERIA TOLERATING HIGH CONCENTRATIONS OF COPPER

BACTERIA as primary film formers help the attachment of larval stages of fouling organisms.[1] Wood[2] believes bacterial fouling of submerged surfaces is not great though he found quite a number of bacteria forming primary film on slides painted with mercury paints, and capable of withstanding up to 250 p.p.m. of $CuSO_4$ and 100 p.p.m. of $HgCl_2$. Waksman[3] also isolated a number of "copper" bacteria from sea-water tolerating 200 mg./L of $CuSO_4.5\,H_2O$. The isolation of "copper" bacteria from marine materials is therefore of interest. The original isolation was made on nutrient sea-water agar containing 250 p.p.m. of $CuSO_4.5\,H_2O$. Three groups were noticed.

Group I.—Four cultures isolated from chanks (*Turbinella pyrum*). These were gram-negative, straight, medium-sized, non-spore-forming, actively motile, monotrichous rods. They failed to grow in fresh-water media or in milk. Acid was produced from glucose, sucrose, maltose and arabinose but not from lactose. Starch was hydrolysed, gelatin rapidly liquefied and indole produced. Nitrates were reduced to nitrites and denitrified vigorously. H_2S was not produced. The culture tolerated 1,000 p.p.m. $CuSO_4$. It is named as *Pseudomonas turbinellæ* n. sp.

Group II.—Three cultures from pearl oysters (*Pinctada vulgaris*). These were yellow pigmented, gram-negative, thin, straight, medium-sized, non-sporing, peritrichous rods. Growth was obtained on fresh-water media also. Acid was slowly produced from glucose, sucrose and maltose but not from lactose, arabinose, and glycerol. Starch was not hydrolysed. Gelatin was slowly liquefied, indole and H_2S not produced. Milk was peptonized slowly, becoming alkaline. Nitrates were reduced to nitrites and gas produced slowly. They tolerated upto 750 p.p.m. $CuSO_4$. They have been named as *Flavobacterium pinctadum* n. sp.

Group III.—One culture from pearl oyster. This white, viscous culture, was a gram-negative rod. The rods were motile with peritrichous flagella, medium-sized to long and non-sporing. No growth was obtained on fresh-water media or in milk. Sugars were not fermented. Starch was hydrolysed; gelatin was liquefied; indole produced; H_2S not produced. Nitrates were reduced to nitrites and denitrified slowly. It tolerated 500 to 750 p.p.m. $CuSO_4$, and is named *Achromobacter viscosus* n. sp.

On primary isolation, the colonies of these had a brown "copper" colour. Tolerance of 750-1,000 p.p.m. of $CuSO_4$ is the highest recorded by any worker for bacteria. The organism from chanks is a typical marine form,[1] failing to grow in fresh-water media. It is quite interesting to note that the conditions necessary for development of fouling organisms,[1] *viz.*, reduction of nitrates to nitrites and to nitrogen, thereby increasing the alkalinity of the medium, protection of fouling organisms from the toxic constituents such as Cu, etc., are created by these "copper" bacteria. Detailed description of these will be published elsewhere.

My thanks are due to Sri. R. Venkataraman for his keen interest and helpful suggestions and to the Director of Industries and Commerce for permission to publish this note.

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December 12, 1955.

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A NEW BACTERIAL LEAF SPOT ON *CLEOME MONOPHYLLA*

A BACTERIAL leaf-disease inciting minute, round spots on the lower surface of *Cleome monophylla* L. leaves was observed at Pimpri near Poona in August 1954. Infection first appearing as water-soaked spots becomes visible on the upper surface as pale brown, round areas surrounded by yellow halo. The necrotic spots increased in size upto 1·5 mm. and later turned dark brown with whitish centre. Similar infection spots appeared also on the siliqua. Comparative studies indicated that the pathogen inciting disease on *Cleome* is undescribed. It is presented as a new species with the name *Xanthomonas cleomei* with the technical description as follows:

Short rods; mostly single, monotrichous, rarely lophotrichous; $0{\cdot}76 \times 1{\cdot}93\,\mu$; aerobe; gram-negative; capsulated; non-spore-former; not acid-fast; colonies on potato dextrose agar plates are circular with entire margin, smooth, shining, convex with striations at the periphery only, measuring 2·0 mm. in 8 days, colour picric yellow (Ridgway); gelatin liquefied; starch hydrolysed; casein digested; milk peptonised; litmus slowly reduced; hydrogen sulphide produced from peptone; ammonia not produced from peptone; nitrate not reduced; M.R. and V.P. tests negative; acid but no gas from dextrose, maltose, sucrose, lactose; no growth in salicin, dulcitol and oxalic acid; optimum growth at 27-31° C.; thermal death point about 52° C., pathogenic to *Cleome monophylla* L. and *Gynandropsis pentaphylla* (Horticultural variety) producing spots on leaves and siliqua; found at Pimpri near Poona.

Details will be published elsewhere.

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EFFECT OF TEMPERATURE ON DEVELOPMENT OF MIRACIDIA OF *GIGANTOCOTYLE EXPLANATUM* (PARAMPHISTOMATIDAE: TREMATODA)

THOUGH a number of life-histories have been worked out of various digenetic trematodes in India, as well as abroad, little attention seems to have been paid to the effect of temperature on development. In the present studies, the effect of temperature on the development of miracidia of *Gigantocotyle explanatum*,[1,2] an

amphistome commonly found in the liver of cattle and buffalo, has been studied.

The eggs when kept at 82° F. hatch out into miracidia in 11-12 days and at 85° F. in 10-11 days, although the hatching continues for another 3-4 days. At 97-99° F., the eggs take only 9 days and when kept at 104° F., the eggs do not show any development and all of them die.

In another series of experiments it was found that unembryonated eggs can withstand a temperature of 50° F. for 14 days (336 hours) without any harm. Further, the period of refrigeration has no effect on subsequent development of the eggs. The unembryonated eggs however die if kept at 50° F. for 600 hours.

When fully embryonated eggs were used, it was found that the miracidia which were ready to hatch can withstand a temperature of 50° F. for 6-7 days only and if kept for 9 days and onwards, they die.

These studies seem to be specially interesting in the sense that live material or eggs only, can be packed in ice and sent almost anywhere by air and be available for life-history studies.

The experiments are being continued and a full account will be published elsewhere.

Dept. of Zoology, Kr. Suresh Singh.
The University, Lucknow,
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A METHOD FOR OBTAINING ALGAL CULTURES FREE FROM ASSOCIATED MICRO-ORGANISMS

During investigations on the microbial deterioration of cotton textiles in these laboratories, it was frequently observed that in localities characterised by heavy rainfall, algæ appear in addition to fungi and bacteria on fabrics exposed to weathering.[1,2] In the presence of algal growth, a fabric showed comparatively greater deterioration than in its absence.[2] It was therefore considered of interest to study the role of algæ in the degradation of exposed fabrics.

A prerequisite to such a study is the isolation and the culturing of algæ free from associated micro-organisms such as fungi and bacteria. Among the most important methods so far adopted for this purpose are: (i) exposure of algal cultures to ultra-violet light,[3,4] (ii) repeated transfer of growing algal cells,[5,6] and (iii) treatment with antibiotics.[7] These methods were tried, but as experienced by other workers[6,8] did not prove successful. The object of this note is to draw attention to a method which has been newly evolved, using mercuric chloride for the purification of the algal culture.

In the new method, the algal suspension is transferred to a Buchner funnel and filtered so as to secure an uniform deposit of the alga on the filter-paper. Small pieces (approximately 1 sq. cm. in area) of the filter-paper coated with alga are treated separately in test-tubes with aqueous mercuric chloride solutions of different concentrations (varying from 1 : 1,000 to 1 : 10,000) for periods ranging from 2-10 minutes. Pieces after treatment are repeatedly washed under aseptic conditions with sterilized water and planted in test-tubes containing separately nutrient broth and Detmer solution. They are then incubated at 28 ± 2° C. in diffused light. Sets of test-tubes showing algal growth in Detmer solution but no turbidity in corresponding nutrient broth tubes are selected and the cultures so obtained are tested for their purity by standard methods[9] for the presence of actinomycetes, azotobacter, anaerobic and other types of bacteria.

The above technique was recently applied by the authors to an alga isolated from cotton fabrics exposed at Bombay during 1951-52. Treatment with mercuric chloride of dilution 1 : 5,000 for 5 minutes effectively purified the culture of *Chlorella ellipsoidea* Gerneck free from associated micro-organisms.

Our thanks are due to Dr. M. O. P. Iyengar for the identification of the culture.

Tech. Development Estt. Lab., Kanpur, *January* 16, 1956.
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REVIEWS

The Foreseeable Future. By Sir George Thomson. (Cambridge University Press), 1955. Pp. vii + 166. Price 10 *sh.* 6 d.

What will life be like, if technology as we know it today is given a chance to progress unimpeded? An answer to this interesting question is provided by Sir George Thomson in his recent book with title as above.

For purposes of presentation, Thomson assumes firstly that the world will continue to be peaceful or at least that such wars as may arise may not do vastly more damage than those of the immediate past; and secondly, that the promise of technology may never transcend what is permissible under the physical laws, which are inexorable in nature and which he terms as 'principles of impotence'. With the limits thus set, he proceeds to the consideration of the possibilities of technological advancement in regard to energy and power, materials, transport and communications, meteorology, and food, devoting to each a separate chapter. The last three chapters lie almost on the border-line he has set himself for study, and deal respectively with: some applications of biology, some social consequences, and thought—artificial and natural. The first five chapters naturally constitute the best part of the work and are the least controversial.

In regard to energy and power, Sir George is disposed to be rather generous, and assures us that there is nothing to prevent us from getting all the power we want even if the supply of coal and oil should fail. He observes that in the not distant future the nuclear reactions which produce the energy of the hydrogen bomb will have been tamed, and we may fairly assume that electrical energy can continue to be produced in any quantities we want, and at a price not exceeding that at which it is available today.

It is only to be expected that with our ability to make materials with much higher breaking stresses than at present available, engineering structures as well as architecture will have been profoundly modified. We may expect that improved materials will allow many kinds of design to be made which are much lighter and more flexible.

In the field of transport and communications, Thomson's expectations are relatively modest. According to him, there would be no object in travelling to Australia with half the speed of light, if it took half-an-hour to buy the ticket and book the luggage! Four or five times the speed of sound is all that may be worthwhile to achieve, and we are not so far away from this even now. He also provides a delightful picture of decentralisation by televising the telephone, and the putting over of business deals by a group of people who have never 'met' in the real sense, but only seen each other on television screens! He is enthusiastic enough about interplanetary travel in spite of the real dangers from meteorites, and is confident that in the next 50 or 100 years the ingenuity of engineers will have overcome such and similar obstacles.

Meteorology bristles with many imponderables, but Sir George is hopeful that climatic changes can be induced either through the medium of artificial rain or by the breeding of plants specially suitable for the reclamation of deserts and arid regions. In regard to food he observes that more will have to be made by the chemist and the bacteriologist in the future than what the farmer can grow, and it ought to be possible to allow much of England to return to parkland and to let the downs go back to grass.

The 'foreseeable future' becomes less distinct if also more exciting as Sir George proceeds to consider, in the next three chapters, the possibilities of improving the species by controlled gene mutation by biologists, domestication of the monkey for doing the kind of work that is now being done by 'unskilled labour' (in India this would approximate to more than 70%), replacement by mechanisation of what is mostly done by human beings, no doubt with a great deal of drudgery, and many similar issues.

A detailed consideration of these chapters will take us far out afield, but it will suffice to say that these chapters raise far more issues than they seem to solve. For example, the process of mechanisation as thoroughgoing as envisaged will have done out of office nearly 90% of humanity. This raises the question which he himself asks, "What will our descendants do with the stupider people in their new world?" Engineers, artists, teachers, scientists, administrators, even salesmen have a place and a good place, but these posts are not for the stupid men."

Likewise, there is a great deal more to be said about 'values', which, as Sir George observes, will be more or less obliterated under a scheme of mechanisation. Perhaps the one to one correspondence he has tacitly assumed between brain and mind may not be true, as he himself admits. The evidence for it is very partial and indirect, and it may be the case that when man has mastered the intricacies of the brain there will still remain the fields of the mind and the soul to make art, religion, patriotism and love as meaningful as before.

One may hold different views from Thomson in regard to these matters, but it is impossible to deny that here is a book which is as thought-provoking as it is eminently readable.

Progress in Nuclear Physics, Vol. IV. Edited by O. R. Frisch. (Pergamon Press, London), 1955. Pp. vii + 379. Price 70 *sh.*

The fourth volume of this series presents the usual "mixed fare", each article in it being a summary of the recent advances in a particular aspect of nuclear physics. Of the nine articles, four deal with experimental results and three with actual experimental technique, and two represent quasi-theoretical accounts relating to nuclear phenomena.

With the rapid development in high energy accelerators, a large mass of experimental data on nuclear collisions has been obtained which has to be sifted and classified before the mathematical physicist is asked to 'explain' them. The first chapter on photo-disintegration of nuclei relates to a phenomenon first demonstrated by Chadwick and Golhaber. It is to be expected that photo-disintegration should be less complex than nucleon-nucleus collisions since the "bombarding" particles are photons. However, the complex character of the charge current vector inside the nucleus presents mathematical difficulties which have no parallel in quantum electrodynamics. It is hoped that experimental work may reveal new physical details which may assist the physicist in working out a more satisfactory theory of nuclear forces. Titterton not only summarises experimental results and techniques but also gives a brief description of the theoretical models as that of Goldhaber and Teller, Levinger and Bethe employed to explain the "giant resonances" in the cross-sections.

Accelerators have made possible the production of heavy ions of high energy whose behaviour, range energy relations and reactions with nuclei have been studied in detail in nuclear emulsions. A clear account is given by Walker in a brief article which is followed by Newton's survey on 'Nuclear properties of very high elements', *i.e.*, those above the double closed shell which is completed at Pb^{208}_{82}. A brief resumé of the general theoretical considerations based on the liquid drop and the unified nuclear models is given.

The chapter on 'Neutron Spectroscopy' by D. J. Hughes deals with the recent advances in a subject whose aim in nuclear physics is similar to that of optical spectroscopy in atomic phenomena. Excitation of the levels by nuclear interactions as well as the decay by emission of particles and photons can be used to study the spacing of the energy levels, the transition probabilities and their relation to the spins and parities of the particles comprising nucleus. In the section on the determination of level parameters, the general trends in establishing the relevance of these parameters to modern nucleon theory are pointed out.

The three articles on actual experimental techniques are: (i) Scintillation spectrometers, by Breitenberger, (ii) Focussing in high energy accelerates, by Pickavance, and (iii) The preparation and chemistry of the transuranic elements, by McKay and Milstead. Breitenberger, besides describing the mechanism of the spectrometer, presents clearly the statistical features of the problem in view of the random nature of the processes involved, the initiation, the photon transfer, the secondary electron cascade, the interruptions to it, the duration of the electron pulse and "after effects". As the editor has observed, the article by McKay and Milstead does not belong to the domain of physics but has been included in view of their recently realised importance to nuclear physics.

Pickavance gives a very neat summary on the two kinds of focussing, phase and directional, in the various types of accelerators, both cyclic and linear.

To describe a "mathematical theory" in any other language than mathematics is a contradiction in terms. Yet such a description is welcome since the mathematical apparatus necessary for a detailed understanding of meson physics is so complex that a physicist even with a "reasonable knowledge" of mathematical techniques finds its difficult to follow the derivation of the results. Dalitz's discussion on the theoretical interpretation of meson-work based on the Tamm-Dancoff method can be appreciated only by one who is well nucleon scattering where he refers to the recent

acquainted with the original work. It is to such a group that this article is intended.

An article on isotopic spin and nuclear reactions by Burcham is written in a similar style. The concept of isotopic spin was introduced to impose a new type of constraint or selection rule among nuclear energy levels—a concept forced by the acceptance of the principle of charge independence of nuclear forces.

The volume justifies its avowed aim of taking stock in nuclear physics, a task undertaken by the concerted attempt by nine experts in the fields. The task is rendered difficult by the rapid shift of the scene of meson theory under the compulsion of new and surprising experimental findings.

A. RAMAKRISHNAN.

Assay Methods of Antibiotics. (A Laboratory Manual). By Donald C. Grove and William A. Randall. (Medical Encyclopædia Inc., 30 East 60th Street, New York. Distributors outside U.S.A.: Interscience Publishers, New York, London.) Pp. xxvi + 238. Price $ 5.00.

This is the best and most comprehensive laboratory manual the reviewer has come across on the subject, and it is bound to be of great value to students, laboratory workers, and clinical pathologists. The methods given are those actually employed by the Food and Drug Administration, Washington. The methods of assay for each of the antibiotics are given not only for the crystalline products but also for all the pharmaceutical dosage forms, combination of antibiotics, body fluids, and animal feeds. The following seventeen antibiotics have been covered: penicillin, streptomycin and dihydrostreptomycin, three tetracyclines, chloramphenicol, bacitracin, tyrothricin, polymyxin, neomycin, erythromycin, carbomycin, viomycin, fumagallin, mystatin and anisomycin. Very useful are also the chapters on the identification of the antibiotics, tests for toxicity, pyrogens and sterility, methods of determining the sensitivity, miscellaneous tests, the physical properties, and details of the culture media, solutions, reagents and equipment required. There is no need to turn to any other literature source to carry out the assays of antibiotics now in use in any type of material. The reviewer feels that the unfortunate misprint of "sodium nitrate" for "sodium nitrite" occurring on pages 25 and 26 had not been there at all in such a very valuable manual. The short foreword of the Editors is philosophical and fascinating. The get-up of the book is good enough to stand the tremendous thumbing and turning over of the pages it is bound to receive.

K. GANAPATHI.

Hydrogen Ions, Vol. I. Fourth Edition. By Hubert T. S. Britton. (Chapman & Hall), 1955. Pp. 476. Price 70 *sh.*

This is the fourth edition of Dr. Britton's book which is well known. The matter has been revised and enlarged in keeping with the post-war developments and the importance of hydrogen-ion concentration measurements in pure and applied chemistry.

The volume consists of 21 chapters. Beginning with the theory of electrometric methods and standard half-elements, the various types of electrodes, together with their limitations, are dealt with in Chapters 3 to 7. Considerable space has been rightly devoted to the glass electrode. Although there are books on this electrode, a concise description of this type is most welcome. The next seven chapters cover E.M.F. measurement, modified potentiometric and other methods, volumetric analysis, abnormal acids, ionisation of dibasic and polybasic acids, and activity theory of solutions. Chapter 15 provides a good outline of the work on which the standardisation of the pH scale is based. The last six chapters deal with the Lowry-Brönsted theory, solutions of known pH, indicator methods and their limitations. There is a useful appendix to calculate pH values from electrode potentials.

The volume is well illustrated with tables and figures, and ends with an author and subject index. Each chapter includes important references. The subject-matter has been ably and concisely presented. The price is perhaps a bit high. This monograph is a valuable contribution in the field of chemistry and can be safely recommended to the research worker, the student of chemistry and the industrial chemist.

T. L. RAMA CHAR.

Particle Size Determination. By R. D. Cadle. (Interscience Publishers), 1955. Pp. xv + 303. Price not given.

The volume under review is the seventh of a series of manuals intended by the publishers to provide straightforward description of laboratory procedures and methods for the evaluation and recording of experimental results. Their objective may be said to have been fully realised in this volume.

The determination of particle size is a vast field and much work has been and is being

carried out on the subject. As a result, a large number of methods is available, and these have been classified into those depending on optical microscopy, electron microscopy, sieve analysis, sedimentation and elutriation, surface area measurements, optical methods and miscellaneous methods. The theoretical basis for each method has been described along with the basic equations. The theoretical as well as the practical limitations of the methods are also indicated. Each of these sections contains a list of references which enhance the value of the work.

Before the actual descriptions of the various methods are given, the methods of sampling, treatment and presentation of data obtained and the selection of the appropriate method of particle size determination are clearly dealt with.

To the scientist or the engineer faced with the task of determining the sizes of particles, this book will serve as a valuable reference work, and it will undoubtedly be a very useful addition to every scientific and technical library.

M. G. SUBBA RAU.

Principles and Practice of Field Experimentation. Second Edition. (Technical Communication 18.) By John Wishart and H. G. Sanders. (Commonwealth Bureau of Plant Breeding and Genetics, Cambridge), 1955. Pp. 133. Price 21 *sh.*

This is a revised edition of an earlier publication by the same authors issued by the Empire Cotton Growing Corporation. The present edition, like the earlier one, is divided into two parts, the first dealing with the principles of experimental design and the second with the practical considerations in the conduct of field experiments. There are 17 chapters in all. While Part II is very much the same as in the earlier edition, Part I has been amplified by the addition of two chapters on confounding and experiments with large number of varieties, and by the insertion of some fresh explanatory material in the text.

The publication has the merit of simplicity, which is important for a large class of readers, and emphasises practical matters that should engage the attention of the experimenter, in addition to the statistical aspects. This former part is frequently omitted from purely statistical text-books. The practical experimenter should find the manual a useful addition to his resources, as it would help him to design simple as well as factorial experiments in randomised block, latin square and split plot designs, and to analyse their results. He would also be introduced to the idea of confounding and incomplete block arrangements for testing a large number of varieties.

As points of criticism, one would like to see a clearer explanation of the nature of experimental error than is contained in the brief section on statistical ideas at the beginning of Chapter I. The definition of partial confounding, given on page 62, does not appear to be correct. The term, as generally understood, signifies confounding of given degrees of freedom in only a part of the experiment, so that information on these degrees of freedom is available from the other part. In the present manual the term is used in the sense that a fraction of the degrees of freedom assigned to some interaction is confounded leaving the remaining component of that interaction unconfounded. Two symbols r and n are used for degrees of freedom and might cause confusion. In the second part, a chapter is devoted to observation plots. The emphasis placed on carrying such plots side by side with experiments proper appears to be excessive. The right procedure even for testing characters like lodging or quality is to conduct the experiment under normal conditions of cultivation. Even in plant breeding, where very small plots with a few regularly spaced plants are unavoidable initially, a practice adopted successfully in India is to try bulks of the more promising progenies in experiments with larger plots, the seed being sown with the common seed-drill.

These are, however, minor points and there is no doubt that the authors and the publishers have rendered a very useful service to the agricultural experimenter by bringing out the present manual.

V. G. PANSE.

Ancient India (*Special Jubilee Number*, No. 9.) (Published by the Director-General of Archæology of India, New Delhi), 1953. Pp. 233. Price Rs. 17.

The Special Jubilee Number of *Ancient India* is issued in commemoration of the completion of the 50th year of the Archæological Survey of India as a Central Organisation. Appropriately, the ten sections of this attractive tome review the progress achieved by the various branches of the Archæological Department. Contributed by official specialists, the articles are all at once factual and authoritative. However, they all seem to fall into set grooves. It would have been desirable perhaps to have

included some contributions from experts who are free from the trammels of official routine.

To say this is not to underrate the value of the contributions presented in this Special Number. In spite of this, the volume furnishes a vivid picture of the main facts of the Department's archæological activities which comprise survey, exploration, excavation, preservation of monuments, epigraphical research and development of museums. Doubtless, commendable progress has been made, thanks to the vision and capacity of stalwarts like Cunningham, Burgess, Marshall and Wheeler.

There are however several directions in which the lapses of the past have to be rectified. A co-ordinated policy of excavation of all potential sites, including those in South India which suffered neglect till 1945, an up-to-date scheme for preserving all the pre-historic and proto-historic sites on the lines adopted in Great Britain, provision of suitable accommodation and well-lit galleries in museums and a determined effort to speed up the publication of the collected inscriptions are but a few of the urgent needs, admitted by the officials themselves. The obstacles are no doubt formidable, but it is the duty of a culture-state to overcome them all. The Jubilee Number contains 122 plates of archæological interest, all excellently reproduced. The get-up of the sumptuous volume is splendid.

K. K. PILLAY.

(*i*) Cestodes of Whales and Dolphins from the Discovery Collections. By S. Markowski. (*Discovery Reports*, Vol. XXVII.) (Cambridge University Press), 1955. Pp. 377-95. Price 12 *sh.* 6 d. **(*ii*) Mysidacea.** By O. S. Tattersall. (*Discovery Reports*, Vol. XXVIII), 1955. Pp. 1-190. Price 65 *sh.*

(i) Eighty-eight samples of adult cestodes and encysted larval stages were collected from the intestines and blubber respectively of seventy-three whales and seven dolphins caught off South Africa and different positions in the Southern oceans. Two larval stages are described and the adults are identified to belong to seven Tetrabothriid species belonging to the three genera *Tetra bothrius*, *Trigonocotyle* and *Priapocephalus* and to the eight species, *Diplogonophorus balænopteræ*. The author has drawn attention to the specific differences being found in the testes, the eggs, the embryos and the longitudinal muscles of mature segments. A discussion of the absense of host specificity among the parasites studied, make this report of general interest.

(ii) The author has examined over 5,000 specimens collected from 391 stations in the South Atlantic and Southern oceans and has shed considerable light on the classification of the mysids which not only continue to grow long after sexual maturity, but acquire new features of appendages. By examining larger numbers of specimens of all sizes, she has elucidated the true identity of younger individuals of species of *Gnathophausia* and *Eucopia*, and has more or less defined the limits of variation within different species, enabling easy identification of any mysid specimen. A total of 36 genera and 95 species are described from not only the *Discovery Collections*, I and II, but also that made by R. R. S. "William Scoresby".

This report has also extended our knowledge of the geographical distribution of many mysid species. That there is no evidence of bipolarity and that the many species recorded from the Northern and Southern Hemispheres may be continuous at deeper levels of ocean, are important conclusions. The author has had the student of taxonomy in mind whom she has undoubtedly helped with a large number of useful figures, tabulated comparisons and lists of species and localities.

Both these issues will be useful additions to libraries.

C. P. GNANAMUTHU.

Books Received

Fundamentals of Electroacoustics. By F. A. Fischer. (Interscience Publishers), 1955. Pp. ix + 186. Price $ 6.00.

Treatise on Inorganic Chemistry, Vol. I. By H. Remy. (Elseviers), 1956. Pp. xv + 866. Price £ 5.35.

Statistical Methods for Agricultural Workers. By V. G. Panse and P. V. Sukhatme. (Indian Council of Agricultural Research, New Delhi), 1956. Pp. xvi + 361. Price Rs. 15.

Structure Reports for 1942-44, Vol. 9. Edited by A. J. C. Wilson. (N. V. S. Oosthoek's Uitgevers, MIJ, Utrecht), 1955. Pp. viii + 448. Price Dfl. 65.

Buyers' Guide to European Machinery. (The Organisation for European Economic Co-operation, Paris), 1955. Pp. 46. Price 3 *sh.* 6 d.

A Colored Atlas of Some Vertebrates from Ceylon Serpentoid Reptilia, Vol. 3. By P. E. P. Deraniyagala. (Ceylon National Museum), 1955. Pp. xviii + 121. Price not given.

The Dynamics of Living Protoplasm. By L. V. Heilbrunn. (Academic Press), 1956. Pp. vii + 327. Price $ 6.50.

SCIENCE NOTES AND NEWS

Comparative Flower Weight in Common Jasmines

Shri G. S. Bhatnagar, National Botanic Gardens, Lucknow, observes as follows:

The average flower weight in common jasmines has been the least utilized of all characters to distinguish between the various species of the same genus and the different varieties in the same species. This may be inferred from the average number of flowers in a kg. weight given in the following: *Jasminum Sambac*: *Mungra*, 400; *Rai Bela*, 1,600; *Motia*, 2,000; *Desi Bela* 4,000; *J. pubescens*: Giant, 4,600; Violet (7 sepals), 6,000; *Kund*, 7,500; *J. rigidum*, 8,000; *J. arborescens* (Niwari), 10,000; *J. sambac* (single), *Hazara Bela*, 10,000; *J. grandiflorum* (Chameli), 13,000; *J. flexile*, 13,000; *J. pubescens* (Violet), 5 sepals, 15,600; *J. auriculatum* (Juhi), 20,000.

Making Atoms Visible

The atomic structure of a surface may be seen clearly in the latest model of the field ion microscope, developed by Erwin Muller, Professor of Physics at Pennsylvania State University. Hitherto, the instrument could present only blurred picture of some large-sized atoms widely scattered over the surface, but now all the atoms are clearly visible. The microscope operates with a field strength of 5 million volts per centimetre. Built entirely of glass, it contains sealed-in wires used to apply up to 30,000 volts.

The instrument resembles two thermos bottles, one inside the other. Low temperatures of the order provided by liquid air are necessary for good microscope resolution. Within the vacuum is a fine tungsten wire, its tip coated with the substance to be studied. The surface of the tip is shown on a fluorescent screen. Helium is used to make the ions, which in turn produce the image on the fluorescent screen.

Multi-Purpose Particle Accelerator

A new 3-million-volt Van de Graaf particle accelerator, which will serve as a powerful and versatile machine radiation source has been announced by the High Voltage Engineering Corporation, Cambridge, Mass.

The 9-ton supervoltage generator is designed to produce nearly all the fundamental radiations—electrons, X-rays, positive ions or neutrons. Conversion of the machine from production of one type of radiation to another is a relatively simple step, achieved through use of appropriate components manufactured by High Voltage. For example, the accelerator can be shifted from electron processing to X-ray production by replacing the beam scanner of the machine with a special heavy metal target 1" in diameter and 1/8" thick.

The new machine has a power output rating of 3,000 watts of radiation at 3-million volts. It is claimed that this unit will produce a radiation field several hundred times more intense than the most powerful radioactive cobalt source now in industrial use.

New Transistor for Very High Frequencies

Performance of the original junction transistor, announced by Bell Laboratories in 1948, was limited to lower frequency ranges. This earlier basic device is a three-layer "sandwich" of germanium sealed in a metal can a fraction of an inch in diameter. The outside layers are of *n*-type (negative) germanium; the central layer is of *p*-type (positive) germanium. Wire leads connect to each of the three layers and extend outside the can.

The more recent experimental device, known as the junction tetrode transistor, has been made to perform at very high frequencies by reducing the width of the germanium bar and the central *p*-layer, and by adding a fourth electrode. New techniques for producing the thin middle layer have recently made possible an almost ten-fold reduction in its width. In the billion-cycle transitors, this layer is less than two ten-thousands of an inch wide.

Telephone engineers are especially interested in broadband devices, such as the junction tetrode transistor, which enable hundreds of telephone conversations to be carried over a single pair of wires at one time. Until now this job has been done exclusively by vacuum tubes.

Silicon Power Rectifier

A tiny new electronic device made of extremely pure silicon has been announced by Bell Telephone Laboratories recently. An efficiency of more than 98% of the theoretical limit is claimed for the device. Two of the new rectifiers, when made about the size of

peas, linked together, and mounted on a cooling fin, will furnish more than 20 amp. D.C. at 100 volts. This amounts to 2,000 watts—with only 20 watts lost through heat. The new silicon rectifiers provide 5,000 times more current than conventional rectifiers of the same size, thus permitting miniature operating units.

Use of Waste Heat from Nuclear Reactors

Waste heat generated by nuclear reactors is being used for large-scale space heating at the Atomic Energy Commission's Hanford Plant, U.S.A. The heat is obtained from coolant waters and is being used as follows: the coolant water is pumped to a heat exchanger, where it gives up its heat to an ethylene glycol water solution, which in turn transmits the heat to air-conditioning systems in various Hanford buildings. The reactor coolant is held until its radioactivity level has decreased to a point where it can safely be discharged into the river.

Mixed Nitrogen-Phosphorus Fertilizer

A mixed nitrogen-phosphorus fertilizer prepared from phosphate rock and using hydrochloric acid and ammonium sulphate is reported by Gadre and Gupta in the *Journal of Scientific and Industrial Research* (1956, 15 A, 84). The product is a free-flowing powder containing 15% P_2O_5 (90% of which is citrate-soluble) and 7·4% nitrogen as ammonium chloride. The fertilizer value of the product has been assessed by the Indian Agricultural Research Institute, New Delhi, and it has been found to be superior to ammonium sulphate and 'superphosphate alone' treatments, but is slightly inferior to an equivalent mixture of ammonium sulphate and superphosphate.

Tritium Estimation in Water Samples

A new method for measuring the concentration of tritium in water samples, is reported by J. F. Cameron in a recent issue of *Nature* (1956, 176, 1,264). The method, which is both simple and rapid, consists of introducing the tritium in the form of water vapour as part of the filling of an internal gas counter. Any tritium atoms disintegrating inside the sensitive volume of the counter give rise to counts, and from the observed count-rate the number of tritium atoms present is evaluated. The normal working pressure of the vacuum apparatus is 1 micron, which can easily be obtained with a single-stage rotary vacuum pump and a liquid-nitrogen trap.

Banana Wilt Disease

In recent investigations, in Jamaica, of Panama disease or vascular wilt disease of bananas (*Fusarium oxysporum f. cubense*), J. Rishbeth has confirmed earlier findings on the mode and progress of infection and has contributed some new and interesting information on this important disease and on the biology of its causal organism (*Ann. Bot.*, 1955, N.S. 19, No. 75, 293). The pathogen has proved difficult to isolate from soil by plating, but it can be detected in soil by using a suitable host. Thus when small bananas were grown in pots under appropriate conditions, pathogenic isolates of *F. oxysporum* produced rhizome infections, whereas other isolates did not. When *F. oxysporum* isolates were obtained by plating from various sources, the proportions which proved to be pathogenic were: 91% from the rhizome of pseudostem of plants showing typical wilt; 29% from variously affected roots; and none from soil. The information now available suggests that the banana pathogen, like other parasitic forms of *F. oxysporum*, has a limited host range; however, it has now been shown to cause a limited root infection of *Heliconia psittacorum* and may possibly originate on species such as this related to the banana. An account is also given in the paper of the development of the disease in sites which had been replanted after previous infection and abandonment.

Asian Wild Life Conservation

Based on the findings of a recent study tour of 30 countries in the Middle East and South and South-East Asia, Lee M. Talbot, of the University of California, has made the following proposals to the International Union for the Protection of Nature to meet the immediate needs for preservation of threatened species and for general wild life conservation: (*i*) The publication of an illustrated children's text-book giving a simplified introduction to conservation so as to educate and stimulate wide general interest; (*ii*) The appointment of a wild life adviser who would be available to governments that request his services to fulfil the immediate need for a technical approach to the problems of wild life and the establishment of park areas; (*iii*) The establishment of a programme to assist the authorities in these countries to set up their own wild life technician training organizations; (*iv*) The conduct of ecological studies of the principal animal species in order to obtain the necessary data

on which to base effective management programmes.

Persons interested in the work of the IUPN are encouraged to write to the Secretary-General at the Union's new address: 31 Rue Vautier, Brussels, Belgium.

Relative Merits of Soil Conditioners

With the aid of a new test for measuring the cohesive strength of wet soil crumbs, W. W. Emerson, of Rothamsted Experimental Station, has compared the performance of several materials offered for stabilising soil granules against rain and thus improving aeration and preventing erosion and "capping".

It was noted that whereas the samples treated with polyvinyl acetate remained unchanged in size, those treated with carboxylated polymers swelled considerably. It was inferred that soil conditioners fall into two groups according to the nature of the molecular linkage—interlamellar in the case of the vinyls and dextran, and edge-linkage with the carboxylated polymers. Greater efficiency of the latter type of alginate also failed in acid soils, the cause being attributed to precipitation as calcium alginate (*J. Agric. Sci.*, Feb., 1956).

Institution of Chemists (India)—Associateship Examination, 1956

The Sixth Associateship Examination of the Institution of Chemists (India), will be held in November 1956. The last date for receiving applications from intending candidates is 31st July 1956. The Examination in Group A (Analytical Chemistry) is divided into the following nine sections and the candidates will be examined in any two of them according to their choice, in addition to General Chemistry including Organic, Inorganic, Physical and Applied Analytical Chemistry: (1) Analysis of Minerals, Silicates, Ores and Alloys; (2) Analysis of Drugs and Pharmaceuticals; (3) Analysis of Foods; (4) Analysis of Water and Sewage; (5) Biochemical Analysis; (6) Analysis of Oils, Fats and Soaps; (7) Fuel and Gas Analysis; (8) Analysis of Soils and Fertilisers; and (9) Analysis Connected with Forensic Chemistry.

Candidates registering their names as examinees *by the 31st May* 1956, will be entitled to avail of the tutorial classes.

Further enquiries may be made to the Honorary Secretaries, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

XIV International Dairy Congress

The Government of India is participating in the Fourteenth International Dairy Congress, which is scheduled to be held at Rome during the last week of September 1956. The topics for discussion at the Section Meetings and at the Conference have been selected with a view to focuss attention on the problems of milk production, manufacture of milk products and consumption of dairy products in various parts of the world, and the developmental programmes undertaken for increasing milk consumption, particularly in underdeveloped areas. On this occasion, the Organising Committee of the Congress intend publishing an International Dairy Index-Book containing particulars about important dairy research and educational centres, official and private dairy organisations, dairy manufacturers and dealers of dairy machinery and equipment in different countries. Dr. K. C. Sen, Director of Dairy Research, Government of India, Ministry of Food and Agriculture, New Delhi, has been appointed as the Liaison Officer for the International Dairy Congress in India.

Award of Research Degree

The Gujarat University has awarded the Degree of Ph.D. to Shri S. V. Venkateswaran for his thesis entitled "Studies in Meteorology".

The University of Rajputana has awarded the Degree of Ph.D. to the following for theses indicated against each: Sri. Vinayak Laxman Talekar—"Studies of Rectification in a Gas (Nitrogen) Discharge and Other Published Work"; Sri. Gopichand Patni—"Contributions to the Study of Ballistics"; Sri. Kuthoor Sundaresa Srinivas—"Studies in Synthetic Antimalarials".

The University of Calcutta has awarded the Ph.D. Degree in Biochemistry to Shri M. L. Sen Gupta for his thesis entitled: "Treatment of Groundnut Oil with Clays and Its Chromatographic Separation on Alumina".

336-56. Printed at The Bangalore Press, Bangalore City, by C. Vasudeva Rao, Superintendent, and Published by A. V. Telang, M.A., for the Current Science Association, Bangalore.
Editor: Prof. G. N. Ramachandran, A. C. College of Technology, Madras 25.

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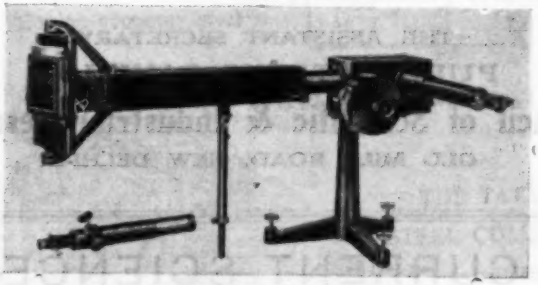

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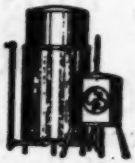

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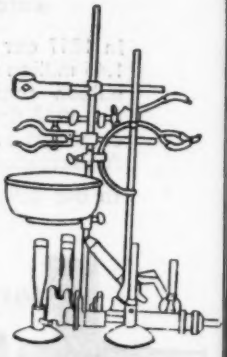

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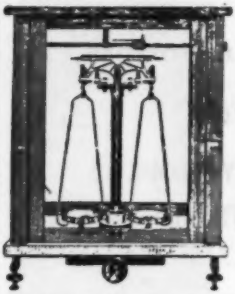

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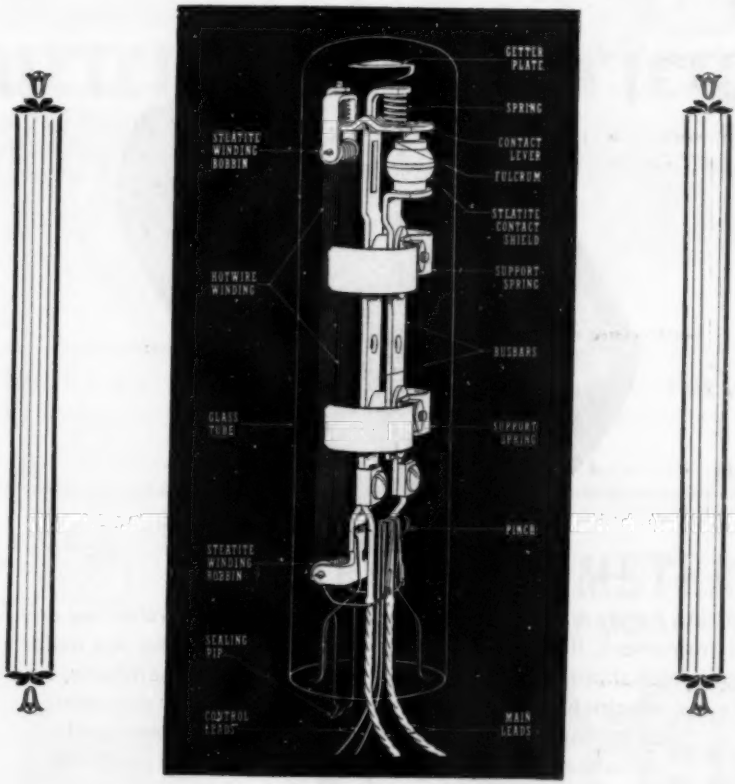

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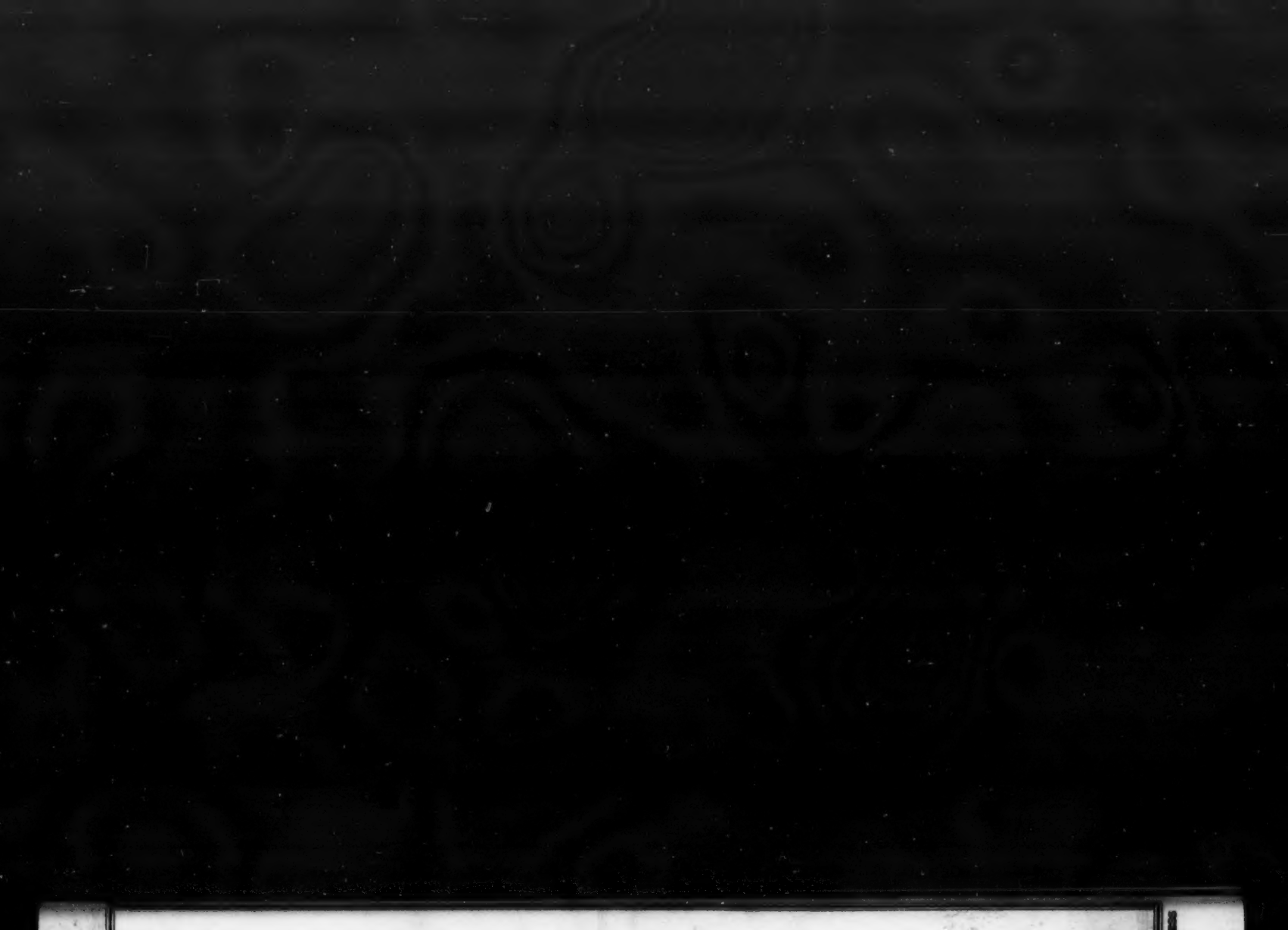
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